

PCT/US04/30431

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
28 March 2002 (28.03.2002)

PCT

(10) International Publication Number  
WO 02/24655 A1

(51) International Patent Classification<sup>7</sup>: C07D 217/24, A61K 31/472

(21) International Application Number: PCT/US01/29013

(22) International Filing Date:  
17 September 2001 (17.09.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/234,389 20 September 2000 (20.09.2000) US

(71) Applicant (for all designated States except US): MERCK & CO., INC. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065-0907 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): CLAREMON, David, A. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065-0907 (US). MCINTYRE, Charles, J. [US/US]; 126 East Lincoln Avenue, Rahway, NJ 07065-0907 (US). LIVERTON, Nigel, J. [GB/US]; 126 East Lincoln Avenue, Rahway, NJ 07065-0907 (US).

(74) Common Representative: MERCK & CO., INC.; 126 East Lincoln Avenue, Rahway, NJ 07065-0907 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ISOQUINOLINONE POTASSIUM CHANNEL INHIBITORS

(57) Abstract: The present invention concerns certain isoquinolinone compounds and their utility as inhibitors of voltage-dependent potassium channels or currents, such as  $K_{1.5}$  and  $I_{Kr}$ , that could serve as targets for the treatment of cardiac arrhythmias especially atrial arrhythmias. The present invention also provide a method for treating or preventing conditions which respond to the inhibition of potassium channels or currents, such as cardiac arrhythmias and more especially atrial arrhythmias. The present invention further includes pharmaceutical formulations and a process of making a pharmaceutical composition comprising a compound of certain isoquinolinone or its pharmaceutically acceptable salts, hydrates, solvates, crystal forms, and stereoisomers thereof, and a pharmaceutically acceptable carrier.

WO 02/24655 A1

21347  
#3

**TITLE OF THE INVENTION****ISOQUINOLINONE POTASSIUM CHANNEL INHIBITORS****FIELD OF THE INVENTION**

- 5           The present invention is directed to class of isoquinolinone compounds that are useful as potassium channel inhibitors, which show antiarrhythmic properties.

**BACKGROUND OF THE INVENTION**

- 10           Mammalian cell membranes perform very important functions relating to the structural integrity and activity of various cells and tissues. Of particular interest in membrane physiology is the study of trans-membrane ion channels which act to directly control a variety of physiological, pharmacological and cellular processes. Numerous ion channels have been identified including calcium (Ca), sodium (Na) and potassium (K) channels, each of which have been analyzed in detail  
15 to determine their roles in physiological processes in vertebrate and insect cells.

- A great deal of attention has been focused on potassium channels because of their involvement in maintaining normal cellular homeostasis. A number of these potassium channels open in response to changes in the cell membrane potential. Many voltage-gated potassium channels have been identified and are  
20 distinguishable based on their electrophysiological and pharmacological properties. Potassium currents have been shown to be more diverse than sodium or calcium currents and also play a role in determining the way a cell responds to an external stimulus. The diversity of potassium channels and their important physiological role highlights their potential as targets for developing therapeutic agents for various  
25 diseases.

- Inhibitors of potassium channels lead to a decrease in potassium ion movement across cell membranes. Consequently, such inhibitors induce prolongation of the electrical action potential or membrane potential depolarization in cells containing the inhibited or blocked potassium channels. Prolonging of the electrical  
30 action potential is a preferred mechanism for treating certain diseases, e.g., cardiac arrhythmias (Colatsky et al., Circulation 82:223 5, 1990). Membrane potential depolarization is a preferred mechanism for the treating of certain other diseases, such as those involving the immune system (Kaczorowski and Koo, Perspectives in Drug Discovery and Design, 2:233, 1994). In particular, blocking potassium channels has  
35 been shown to regulate a variety of biological processes including cardiac electrical

activity (Lynch et al., *FASEB J* 6:2952, 1992; Sanguinetti, *Hypertension* 19: 228, 1992; Deal et al., *Physiol. Rev.* 76:49, 1996), neurotransmission (Halliwell, "K<sup>+</sup> Channels in the Central Nervous System" in *Potassium Channels*, Ed. N. S. Cook, pp348, 1990), and T cell activation (Chandy et al., *J. Exp. Med.* 160:369, 1984; Lin et al., *J. Exp. Med.* 177:637, 1993). These effects are mediated by specific subclasses or subtypes of potassium channels.

Potassium channels have been classified according to their biophysical and pharmacological characteristics. Salient among these are the voltage dependent potassium channels, such as K<sub>v</sub>1. The K<sub>v</sub>1 class of potassium channels is further subdivided depending on the molecular sequence of the channel, for example K<sub>v</sub>1.1, K<sub>v</sub>1.3, and K<sub>v</sub>1.5. Functional voltage-gated K<sup>+</sup> channels can exist as multimeric structures formed by the association of either identical or dissimilar subunits. This phenomena is thought to account for the wide diversity of K<sup>+</sup> channels. However, subunit compositions of native K<sup>+</sup> channels and the physiologic role that particular channels play are, in most cases, still unclear.

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia in clinical practice and is likely to increase in prevalence with the aging of the population. Currently, AF affects more than 1 million Americans annually, represents over 5% of all admissions for cardiovascular diseases and causes more than 80,000 strokes each year in the United States. While AF is rarely a lethal arrhythmia, it is responsible for substantial morbidity and can lead to complications such as the development of congestive heart failure or thromboembolism. Currently available Class I and Class III antiarrhythmic drugs reduce the rate of recurrence of AF, but are of limited use because of a variety of potentially adverse effects including ventricular proarrhythmia. Because current therapy is inadequate and fraught with side effects, there is a clear need to develop new therapeutic approaches.

Antiarrhythmic agents of Class III are drugs that cause a selective prolongation of the duration of the action potential without significant cardiac depression. Available drugs in this class are limited in number. Examples such as sotalol and amiodarone have been shown to possess interesting Class III properties (Singh B.N., Vaughan Williams E.M. "A Third Class Of Anti-Arrhythmic Action: Effects On Atrial And Ventricular Intracellular Potentials And Other Pharmacological Actions On Cardiac Muscle, of MJ 1999 and AH 3747" *Br. J. Pharmacol* 1970; 39:675-689. and Singh, B. N., Vaughan Williams E. M., "The Effect Of Amiodarone,

A New Anti-Anginal Drug, On Cardiac Muscle", *Br J. Pharmacol* 1970; 39:657-667.), but these are not selective Class III agents. Sotalol also possesses Class II effects which may cause cardiac depression and is contraindicated in certain susceptible patients. Amiodarone, also is not a selective Class III antiarrhythmic agent because it possesses multiple electrophysiological actions and is severely limited by side effects (Nademanee, K. "The Amiodarone Odyssey". *J. Am. Coll. Cardiol.* 1992; 20:1063-1065.) Drugs of this class are expected to be effective in preventing ventricular fibrillation. Selective class III agents, by definition, are not considered to cause myocardial depression or an induction of arrhythmias due to inhibition of conduction of the action potential as seen with Class I antiarrhythmic agents.

Class III agents increase myocardial refractoriness via a prolongation of cardiac action potential duration. Theoretically, prolongation of the cardiac action potential can be achieved by enhancing inward currents (i.e.  $\text{Na}^+$  or  $\text{Ca}^{2+}$  currents; hereinafter  $\text{I}_{\text{Na}}$  and  $\text{I}_{\text{Ca}}$ , respectively) or by reducing outward repolarizing potassium ( $\text{K}^+$ ) currents. The delayed rectifier ( $\text{I}_{\text{K}}$ )  $\text{K}^+$  current is the main outward current involved in the overall repolarization process during the action potential plateau, whereas the transient outward ( $\text{I}_{\text{to}}$ ) and inward rectifier ( $\text{I}_{\text{K1}}$ )  $\text{K}^+$  currents are responsible for the rapid initial and terminal phases of repolarization, respectively. Cellular electrophysiologic studies have demonstrated that  $\text{I}_{\text{K}}$  consists of two pharmacologically and kinetically distinct  $\text{K}^+$  current subtypes,  $\text{I}_{\text{Kr}}$  (rapidly activating and deactivating) and  $\text{I}_{\text{Ks}}$  (slowly activating and deactivating) (Sanguinetti and Jurkiewicz, "Two Components Of Cardiac Delayed Rectifier  $\text{K}^+$  Current: Differential Sensitivity To Block By Class III Antiarrhythmic Agents," *J. Gen. Physiol.* 1990, 96:195-215). Class III antiarrhythmic agents, including d-sotalol and dofetilide predominantly, if not exclusively, block  $\text{I}_{\text{Kr}}$ . Although, amiodarone is a blocker of  $\text{I}_{\text{Ks}}$  (Balser, J.R. Bennett, P.B., Hondeghem, L.M. and Roden, D.M. "Suppression Of Time-Dependent Outward Current In Guinea Pig Ventricular Myocytes: Actions Of Quinidine And Amiodarone." *Circ. Res.* 1991, 69:519-529), it also blocks  $\text{I}_{\text{Na}}$  and  $\text{I}_{\text{Ca}}$ , affects thyroid function, is a nonspecific adrenergic blocker, and acts as an inhibitor of the enzyme phospholipase (Nademanee, K. "The Amiodarone Odyssey". *J. Am. Coll. Cardiol.* 1992; 20:1063-1065). Therefore, its method of treating arrhythmia is uncertain.

Reentrant excitation (reentry) has been shown to be a prominent mechanism underlying supraventricular arrhythmias in man. Reentrant excitation requires a critical balance between slow conduction velocity and sufficiently brief refractory periods to allow for the initiation and maintenance of multiple reentry circuits to coexist simultaneously and sustain AF. Increasing myocardial refractoriness by prolonging action potential duration (APD), prevents and/or terminates reentrant arrhythmias. Most selective Class III antiarrhythmic agents, such as d-sotalol and dofetilide predominantly, if not exclusively, block  $I_{K_r}$ , the rapidly activating component of  $I_K$  found both in atria and ventricles in man.

Since these  $I_{K_r}$  blockers increase APD and refractoriness both in atria and ventricles without affecting conduction per se, theoretically they represent potential useful agents for the treatment of arrhythmias like AF. These agents have a liability in that they have an enhanced risk of proarrhythmia at slow heart rates. For example, torsades de points has been observed when these compounds are utilized (Roden, D.M. "Current Status of Class III Antiarrhythmic Drug Therapy," *Am. J. Cardiol.* 1993; 72:44B-49B).

The ultra-rapidly activating delayed rectifier  $K^+$  current ( $I_{K_{ur}}$ ) is believed to represent the native counterpart to a cloned potassium channel designated  $K_v1.5$  and, while present in human atria, it appears to be absent in human ventricles. Furthermore, because of its rapidity of activation and limited slow inactivation,  $I_{K_{ur}}$  is believed to contribute significantly to repolarization in human atria and thus is a candidate potassium channel target for the treatment of cardiac arrhythmias especially those occurring in the atria. (Wang et al., *Circ. Res.* 73:1061, 1993; Fedida et al., *Circ. Res.* 73:210, 1993; Wang et al., *J. Pharmacol. Exp. Aer.* 272:184, 1995; Amos et al., *J. Physiol.*, 491:31, 1996). Consequently, a specific blocker of  $I_{K_{ur}}$ , that is a compound which blocks  $K_v1.5$ , would overcome the shortcoming of other compounds by prolonging refractoriness in human atria without prolonging ventricular refractoriness that underlie arrhythmogenic after depolarizations and acquired long QT syndrome observed during treatment with current Class III drugs.

Natsugari et al. (EP 0481383) discloses the heterocyclic amine derivatives having an activity of inhibiting acyl-CoA: cholesterol acyltransferase, controlling in mammals, absorption of cholesterol from the intestinal tract and suppressing accumulation of cholesterol ester at the arterial wall thus being useful for prophylaxis and therapy of hypercholesterolemia, atherosclerosis and various diseases

caused by them (e.g. ischemic heart diseases such as cardiac infarction and cerebral blood vessel disorders such as cerebral infarction, apoplexy, etc.).

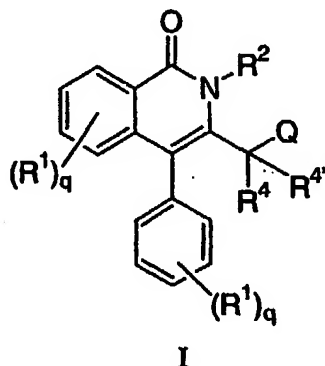
- Natsugari, et al. (EP 0585913) is directed to phenyl substituted heterocyclic compounds which are inhibitors of acylCoA: cholesterol transferase (ACAT) and antagonists of tachykinin receptors, and pharmaceutical compositions containing these compounds, process for preparing these compounds, and the use of these compounds for preparing medicaments for treating hypercholesterolemia and atherosclerosis, and for treating pain, disturbance of micturition and inflammation. Natsugari et al. (*J. Med. Chem.* 38:16; 1995; 3106-3120, "Novel Potent, and Orally Active Substance P Antagonists: Synthesis and Antagonist Activity of N-Benzylcarboxamide Derivatives of Pyrido[3,4-b]pyridine") relates to a synthesis of 4-phenylisoquinolone derivatives and NK<sub>1</sub> (substance P) antagonist activity of the compounds.

- Castle et al. (WO 99/62891) discloses certain thiazolidinone and methathiazanone compounds that are useful as potassium channel inhibitors and for the treatment of cardiac arrhythmias and other diseases, conditions and disorders.

- An object of the present invention is directed to the compounds that are useful as inhibitors of potassium channel function and are selective for atrial tissue avoiding side effects of affecting ventricular repolarization. The potassium channel inhibitors of the present invention may therefore be utilized for the treatment of diseases in which prolongation of cellular action potentials would be beneficial, such as cardiac arrhythmia, and particularly atrial arrhythmia.

## SUMMARY OF THE INVENTION

This invention relates to compounds of general structural Formula I:



5

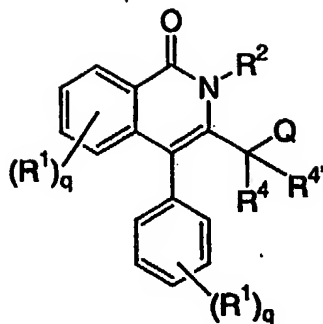
or a pharmaceutically acceptable salts, hydrates, solvates, crystal forms, or stereoisomers thereof, for use as a  $K_v1.5$  potassium channel inhibitor or a  $I_{Kur}$  potassium current inhibitor.

- The compounds of this invention are useful in the treatment of cardiac
- 10 arrhythmia and more specifically atrial arrhythmia in a mammal, which comprises administering a therapeutically effective amount of a compound of Formula I. Also within the scope of this invention is pharmaceutical formulations comprising a compound of Formula I and a pharmaceutical carrier. The present invention further includes a process of making a pharmaceutical composition comprising a compound
- 15 of Formula I or its pharmaceutically acceptable salts, hydrates, solvates, crystal forms, and stereoisomers thereof and a pharmaceutically acceptable carrier.

## DETAILED DESCRIPTION OF THE INVENTION

- The present invention concerns certain isoquinolinone compounds and
- 20 their utility as inhibitors of voltage-dependent potassium channels or currents, such as  $K_v1.5$  and  $I_{Kur}$ , that could serve as targets for the treatment of cardiac arrhythmias especially those occurring in the atria (e.g., atrial flutter and atrial fibrillation). Additionally, the present invention also provide a method for treating conditions which respond to the inhibition of potassium channels or currents, such as cardiac
- 25 arrhythmias and more especially atrial arrhythmias.

An embodiment of the present invention is a compound of structural Formula I:



I

or a pharmaceutically acceptable salts, hydrates, solvates, crystal forms, or  
 5 stereoisomers thereof, wherein:

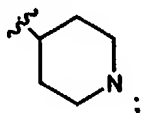
R<sup>1</sup> is:

- (1) hydrogen,
- (2) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- 10 (3) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (4) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or
- (5) halo, wherein halo is fluoro, chloro, bromo, or iodo;

R<sup>2</sup> is:

- 15 (1) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (2) (CH<sub>2</sub>)<sub>n</sub>-(T)[S(O)<sub>m</sub>]<sub>p</sub>R<sup>3</sup>, or
- (3) (CH<sub>2</sub>)<sub>n</sub>-(T)COR<sup>3</sup>;

wherein T is -NH or



- 20 n is: 1, 2, or 3;
- m is: 0, 1, or 2;
- p is: 0 or 1;
- q is: 1, 2, 3, or 4;

25 R<sup>3</sup> is:



(1) aryl, wherein aryl is defined as phenyl or naphthyl which is optionally substituted with one, two or three of the substituents selected from the group consisting of:

- 5 (a) halo, wherein halo is fluoro, chloro, bromo, or iodo,  
(b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
(c) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
(d) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
(e) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy,  
(f) phenyl, and  
10 (g) benzyl;

(2) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

- 15 (a) halo, as defined above,  
(b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
(c) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and  
(d) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy;  
(3) (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with phenyl; or  
20 (4) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy;

R<sup>4</sup> and R<sup>4'</sup> are independently:

- (1) H,  
(2) (C<sub>1</sub>-C<sub>4</sub>)-alkyl,  
25 (3) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl,  
(4) halo,  
(5) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, or  
(6) R<sup>4</sup> and R<sup>4'</sup> are taken together form a (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl ring;

30 Q is:

- (1) NR<sup>5</sup>R<sup>6</sup>, wherein R<sup>5</sup> and R<sup>6</sup> are independently:  
(a) H,  
(b) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
(c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl,

- (d) (C<sub>2</sub>-C<sub>6</sub>)-alkyl-aryl, wherein aryl is defined as phenyl or naphthyl which is substituted with one, two or three of the substituents selected from the group consisting of halo, hydroxy, (C<sub>1</sub>-C<sub>6</sub>)-alkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, phenyl, phenoxy, and nitro,
- 5 (e) (C<sub>1</sub>-C<sub>10</sub>)-alkyl, which is optionally substituted with one, two, or three of the substituents selected from the group consisting of:
- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
  - (b') hydroxy,
  - (c') oxo,
  - 10 (d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
  - (e') phenyl, and
  - (f') (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl; or
- (f) optionally, R<sup>5</sup> or R<sup>6</sup> can be joined with the R<sup>2</sup> substituent in Formula I to form a 5 to 8 atom heterocyclic ring, and the other of R<sup>5</sup> or R<sup>6</sup> is as defined above;
- 15 (2) heterocyclyl, wherein heterocyclyl is defined as a monocyclic or bicyclic ring of 5 to 10 carbon atoms which can be aromatic or nonaromatic, wherein the heterocyclyl is attached to the methylene bearing the R<sup>4</sup> and R<sup>4'</sup> substituents through a N from the heterocyclyl and may optionally contain 1 to
- 20 3 additional heteroatoms selected from N, O or S and is optionally substituted with one, two, or three substituents selected from the group consisting of:
- (a) H,
  - (b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
  - (c) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
  - 25 (d) (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,
  - (e) CO<sub>2</sub>(C<sub>1</sub>-C<sub>6</sub>)-alkyl,
  - (f) CO<sub>2</sub>H
  - (g) oxo, and
  - (h) hydroxy; or
- 30 (3) NH(C=O)R<sup>7</sup>, wherein R<sup>7</sup> is:
- (a) (C<sub>1</sub>-C<sub>13</sub>)-alkyl or (C<sub>1</sub>-C<sub>12</sub>)-alkenyl, which is optionally substituted with one, two, or three substituents selected from the group consisting of:
  - (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,

- (b') hydroxy,  
(c') oxo,  
(d') nitro,  
(e') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
5 (f') NR<sup>5</sup>R<sup>6</sup>,  
(g') NH(CO)O(C<sub>1</sub>-C<sub>6</sub>)-alkyl, wherein (C<sub>1</sub>-C<sub>6</sub>)-alkyl is optionally substituted with phenyl,  
(h') CO(C<sub>1</sub>-C<sub>10</sub>)-alkyl,  
(i') OC(O)(C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
10 (j') CONR<sup>5</sup>R<sup>6</sup>,  
(k') O-aryl, wherein aryl as defined in (o') below,  
(l') S-aryl, wherein aryl as defined in (o') below,  
(m') (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, which is optionally substituted with 1 to 3 substituents selected from the group consisting of (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, CO(C<sub>1</sub>-C<sub>6</sub>)-alkyl, oxo and (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with NO<sub>2</sub>,  
15 (n') (C<sub>5</sub>-C<sub>7</sub>)-cycloalkyl fused with phenyl, wherein (C<sub>5</sub>-C<sub>7</sub>)-cycloalkyl fused with phenyl is optionally substituted with 1 to 3 substituents selected from the group consisting of (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, oxo, and (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
20 (o') aryl, wherein aryl is defined as phenyl or naphthyl, which is optionally substituted with one, two or three of the substituents selected from the group consisting of:  
(a'') halo, as defined above,  
25 (b'') hydroxy,  
(c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
(d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
(e'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, optionally substituted with phenyl,  
30 (f'') phenyl,  
(g'') phenoxy, and  
(h'') nitro;  
(p') heterocyclyl, wherein heterocyclyl is defined as a monocyclic, bicyclic, or tricyclic ring of 5 to 14 carbon atoms  
35 which can be aromatic or nonaromatic and containing from 1 to

3 heteroatoms selected from O, N or S, and the heterocyclyl being optionally substituted or with one, two, or three substituents selected from the group consisting of:

- (a'') H,
- (b'') halo, as defined above,
- (c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (e'') (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,
- (f'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- (g'') phenyl,
- (h'') phenoxy,
- (i'') nitro,
- (j'') CO<sub>2</sub>(C<sub>1</sub>-C<sub>6</sub>)-alkyl, and
- (k'') oxo; and
- (q') S- heterocyclyl, wherein heterocyclyl as defined under (p') above;

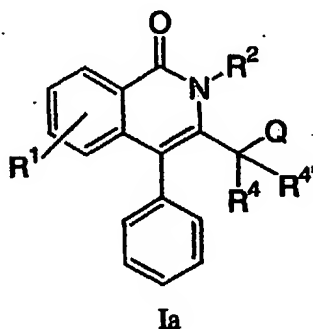
(b) aryl, wherein aryl is defined as phenyl or naphthyl which is optionally substituted with one, two or three of the substituents selected from the group consisting of:

- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
- (b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (c') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- (d') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl;
- (e') phenoxy,
- (f') benzyl, and
- (g') phenyl optionally substituted with (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl;
- (c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, optionally substituted with phenyl; or
- (d) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

- (a') halo, as defined above,
- (b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,

- (c') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and  
 (d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy.

A preferred embodiment of the present invention is isoquinolinone  
 5 compounds of structural Formula Ia:



10 or a pharmaceutically acceptable salts, hydrates, solvates, crystal forms, or stereoisomers thereof, wherein:

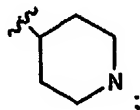
R<sup>1</sup> is:

- 15 (1) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
 (2) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
 (3) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or  
 (4) halo, wherein halo is fluoro, chloro, bromo, or iodo;

R<sup>2</sup> is:

- 20 (1) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
 (2) (CH<sub>2</sub>)<sub>n</sub>-(T)[S(O)<sub>3</sub>]<sub>m</sub>R<sup>3</sup>, or  
 (3) (CH<sub>2</sub>)<sub>n</sub>-(T)COR<sup>3</sup>;

wherein T is -NH or



25

n is: 1, 2, or 3;

m is: 0, 1, or 2;

p is: 0 or 1;

R<sup>3</sup> is:

- 5 (1) aryl, wherein aryl is defined as phenyl or naphthyl which is optionally substituted with one, two or three of the substituents selected from the group consisting of:
- (a) halo, wherein halo is fluoro, chloro, bromo, or iodo,
  - (b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
  - (c) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
  - 10 (d) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
  - (e) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy,
  - (f) phenyl, and
  - (g) benzyl;
- 15 (2) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:
- (a) halo, as defined above,
  - (b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
  - 20 (c) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and
  - (d) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy;
- (3) (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with phenyl; or
- (4) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy;

25 R<sup>4</sup> and R<sup>4'</sup> are independently:

- (1) H,
- (2) (C<sub>1</sub>-C<sub>4</sub>)-alkyl,
- (3) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl,
- (4) halo,
- 30 (5) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, or
- (6) R<sup>4</sup> and R<sup>4'</sup> are taken together form a (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl ring;

Q is:

- 35 (1) NR<sup>5</sup>R<sup>6</sup>, wherein R<sup>5</sup> and R<sup>6</sup> are independently:
- (a) H,

- (b) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
 (c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl,  
 (d) (C<sub>2</sub>-C<sub>6</sub>)-alkyl-aryl, wherein aryl is defined as phenyl or naphthyl which is substituted with one, two or three of the substituents selected from the group consisting of halo, hydroxy, (C<sub>1</sub>-C<sub>6</sub>)-alkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, phenyl, phenoxy, and nitro,  
 (e) (C<sub>1</sub>-C<sub>10</sub>)-alkyl, which is optionally substituted with one, two, or three of the substituents selected from the group consisting of:
- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,  
 (b') hydroxy,  
 (c') oxo,  
 (d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
 (e') phenyl, and  
 (f') (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl; or
- (f) optionally, R<sup>5</sup> or R<sup>6</sup> can be joined with the R<sup>2</sup> substituent in Formula Ia to form a 5 to 8 atom heterocyclic ring, and the other of R<sup>5</sup> or R<sup>6</sup> is as defined above;
- (2) heterocyclyl, wherein heterocyclyl is defined as a monocyclic or bicyclic ring of 5 to 10 carbon atoms which can be aromatic or nonaromatic, wherein the heterocyclyl is attached to the methylene bearing the R<sup>4</sup> and R<sup>4'</sup> substituents through a N from the heterocyclyl and may optionally contain 1 to 3 additional heteroatoms selected from N, O or S and is optionally substituted with one, two, or three substituents selected from the group consisting of:
- (a) H,  
 (b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
 (c) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
 (d) (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,  
 (e) CO<sub>2</sub>(C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
 (f) CO<sub>2</sub>H  
 (g) oxo, and  
 (h) hydroxy; or
- (3) NH(C=O)R<sup>7</sup>, wherein R<sup>7</sup> is:

(a) (C<sub>1</sub>-C<sub>13</sub>)-alkyl or (C<sub>1</sub>-C<sub>12</sub>)-alkenyl, which is optionally substituted with one, two, or three substituents selected from the group consisting of:

- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
- 5 (b') hydroxy,
- (c') oxo,
- (d') nitro,
- (e') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- (f') NR<sup>5</sup>R<sup>6</sup>,
- 10 (g') NH(CO)O(C<sub>1</sub>-C<sub>6</sub>)-alkyl, wherein (C<sub>1</sub>-C<sub>6</sub>)-alkyl is optionally substituted with phenyl,
- (h') CO(C<sub>1</sub>-C<sub>10</sub>)-alkyl,
- (i') OC(O)(C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (j') CONR<sup>5</sup>R<sup>6</sup>,
- 15 (k') O-aryl, wherein aryl as defined in (o') below,
- (l') S-aryl, wherein aryl as defined in (o') below,
- (m') (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, which is optionally substituted with 1 to 3 substituents selected from the group consisting of (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, CO(C<sub>1</sub>-C<sub>6</sub>)-alkyl, oxo and (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with NO<sub>2</sub>,
- 20 (n') (C<sub>5</sub>-C<sub>7</sub>)-cycloalkyl fused with phenyl, wherein (C<sub>5</sub>-C<sub>7</sub>)-cycloalkyl fused with phenyl is optionally substituted with 1 to 3 substituents selected from the group consisting of (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, oxo, and (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- 25 (o') aryl, wherein aryl is defined as phenyl or naphthyl, which is optionally substituted with one, two or three of the substituents selected from the group consisting of:
  - (a'') halo, as defined above,
  - (b'') hydroxy,
  - 30 (c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
  - (d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
  - (e'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, optionally substituted with phenyl,
  - (f'') phenyl,

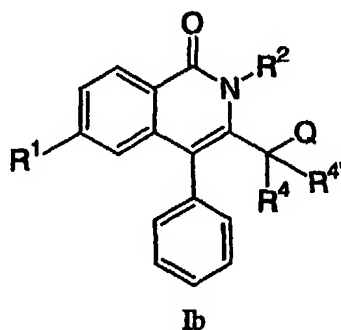


- (g'') phenoxy, and  
(h'') nitro;
- (p') heterocyclyl, wherein heterocyclyl is defined as a  
monocyclic, bicyclic, or tricyclic ring of 5 to 14 carbon atoms  
which can be aromatic or nonaromatic and containing from 1 to  
3 heteroatoms selected from O, N or S, and the heterocyclyl  
being optionally substituted or with one, two, or three  
substituents selected from the group consisting of:
- (a'') H,  
(b'') halo, as defined above,  
(c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
(d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
(e'') (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,  
(f'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
(g'') phenyl,  
(h'') phenoxy,  
(i'') nitro,  
(j'') CO<sub>2</sub>(C<sub>1</sub>-C<sub>6</sub>)-alkyl, and  
(k'') oxo; and
- (q') S-heterocyclyl, wherein heterocyclyl as defined under  
(p') above;
- (b) aryl, wherein aryl is defined as phenyl or naphthyl which is  
optionally substituted with one, two or three of the substituents  
selected from the group consisting of:
- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,  
(b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
(c') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
(d') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl;  
(e') phenoxy,  
(f') benzyl, and  
(g') phenyl optionally substituted with (C<sub>1</sub>-C<sub>4</sub>)-  
perfluoroalkyl;
- (c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, optionally substituted with phenyl; or  
(d) heteroaryl, wherein heteroaryl is defined as a monocyclic or  
bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3

heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

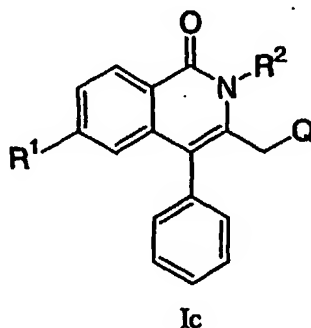
- 5 (a') halo, as defined above,  
 (b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
 (c') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and  
 (d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy.

Another preferred embodiment of the present invention is isoquinolinone compound of structural Formula Ib,



wherein the R<sup>1</sup>, R<sup>2</sup>, R<sup>4</sup>, R<sup>4'</sup>, and Q are as defined above.

15 Another preferred embodiment of the present invention is isoquinolinone compound of structural Formula Ic,



20 wherein R<sup>1</sup>, R<sup>2</sup>, and Q are as defined below:

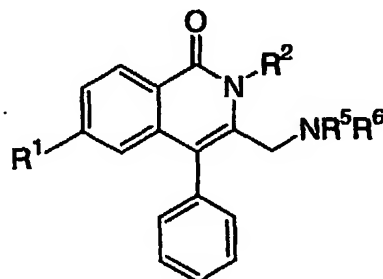
R<sup>1</sup> is (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or halo, wherein halo is fluoro, chloro, bromo, or iodo;

$R^2$  is  $(C_1-C_6)$ -alkyl; and

Q is heterocyclyl which is selected from the group consisting of: pyrrolidinyl, piperazinyl, imidazolyl, morpholinyl, 1,4-dioxo-8-aza-spiro[4,5]decyl, piperidinyl, and 2,3-dihydroindolyl and the heterocyclyl is optionally substituted with one,

- 5 two, or three substituents selected from the group consisting of H,  $(C_1-C_4)$ -alkyl,  $CF_3$ , benzyl, and  $CO_2Et$ .

Another preferred embodiment of the present invention is isoquinolinone compound of structural Formula Id,



10

Id

wherein  $R^1$ ,  $R^2$ ,  $R^5$ , and  $R^6$  are as defined below:

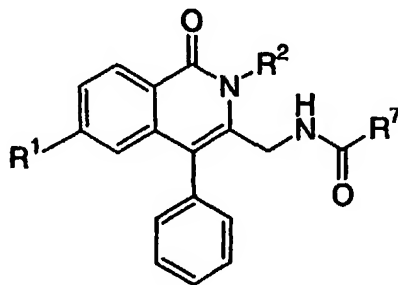
$R^1$  is  $(C_1-C_6)$ -alkoxy,  $(C_1-C_4)$ -perfluoroalkyl,  $(C_1-C_4)$ -perfluoroalkoxy, or halo,

- 15 wherein halo is fluoro, chloro, bromo, or iodo;

$R^2$  is  $(C_1-C_6)$ -alkyl; and

$R^5$  and  $R^6$  are independently:  $(C_1-C_{10})$ -alkyl optionally substituted with  $(C_3-C_7)$ -cycloalkyl,  $(C_1-C_4)$ -perfluoroalkyl, and phenyl.

- 20 Another preferred embodiment of the present invention is isoquinolinone compound of structural Formula Ie,



Ie

wherein  $R^1$ ,  $R^2$  and  $R^7$  are as defined below:

$R^1$  is  $(C_1-C_6)$ -alkoxy,  $(C_1-C_4)$ -perfluoroalkyl,  $(C_1-C_4)$ -perfluoroalkoxy, or halo,

wherein halo is fluoro, chloro, bromo, or iodo;

5  $R^2$  is  $(C_1-C_6)$ -alkyl; and

$R^7$  is:

(a)  $(C_1-C_{13})$ -alkyl or  $(C_1-C_{12})$ -alkenyl, which is optionally substituted with one, two, or three substituents selected from the group consisting of:

- 10 (a') hydroxy,
- (b') oxo,
- (c')  $NR^5R^6$ ,
- (d')  $NH(CO)O(C_1-C_6)$ -alkyl, wherein  $(C_1-C_6)$ -alkyl optionally substituted with phenyl,
- (e')  $CO(C_1-C_{10})$ -alkyl,
- 15 (f')  $OC(O)(C_1-C_6)$ -alkyl,
- (g')  $CONR^5R^6$ ,
- (h') O-aryl, wherein aryl as defined in (l') below,
- (i') S-aryl, wherein aryl as defined in (l') below,
- (j')  $(C_3-C_7)$ -cycloalkyl, which is optionally substituted with 1 to 3 substituents selected from the group consisting of  $(C_1-C_6)$ -alkoxy,  $CO(C_1-C_6)$ -alkyl, and oxo, and  $(C_1-C_6)$ -alkyl optionally substituted with  $NO_2$ ,
- 20 (k')  $(C_5-C_7)$ -cycloalkyl fused with phenyl, wherein  $(C_5-C_7)$ -cycloalkyl fused with phenyl is optionally substituted with 1 to 3 substituents selected from the group consisting of  $(C_1-C_6)$ -alkoxy, oxo, and  $(C_1-C_6)$ -alkyl,
- 25 (l') aryl, wherein aryl is defined as phenyl or naphthyl, which is optionally substituted with one, two or three of the substituents selected from the group consisting of:
- 30 (a'') halo, as defined above,
- (b'') hydroxy,
- (c'')  $(C_1-C_6)$ -alkyl,
- (d'')  $(C_1-C_4)$ -perfluoroalkyl,
- (e'')  $(C_1-C_6)$ -alkoxy, optionally substituted with phenyl

- (f'') phenyl,
- (g'') phenoxy, and
- (h'') nitro;

(m') heterocyclyl, wherein heterocyclyl is defined as a monocyclic, bicyclic, or tricyclic ring of 5 to 14 carbon atoms which can be aromatic or nonaromatic and containing from 1 to 3 heteroatoms selected from O, N or S, and the heterocyclyl being optionally substituted or with one, two, or three substituents selected from the group consisting of:

- (a'') H,
- (b'') halo, as defined above,
- (c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (e'') (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,
- (f'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- (g'') phenyl,
- (h'') phenoxy,
- (i'') nitro,
- (j'') CO<sub>2</sub>(C<sub>1</sub>-C<sub>6</sub>)-alkyl, and
- (k'') oxo; and

(n') S-heterocyclyl, wherein heterocyclyl as defined under (m') above;

(b) aryl, wherein aryl is defined as phenyl or naphthyl which is optionally substituted with one, two or three of the substituents selected from the group consisting of:

- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
- (b') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- (c') phenoxy,
- (d') benzyl, and

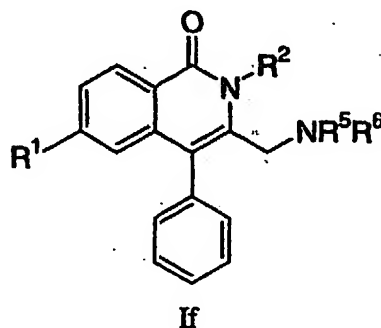
(e') phenyl optionally substituted with (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl;

(c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, optionally substituted with phenyl; or

(d) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

- (a') halo, as defined above,
- (b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (c') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and
- (d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy.

5 Another preferred embodiment of the present invention is isoquinolinone compound of structural Formula If,



10

wherein R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, R<sup>5</sup>, R<sup>6</sup>, and n are as defined below:

R<sup>1</sup> is (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or halo,

wherein halo is fluoro, chloro, bromo, or iodo;

R<sup>2</sup> is (CH<sub>2</sub>)<sub>n</sub>(T)SO<sub>2</sub>R<sup>3</sup> or (CH<sub>2</sub>)<sub>n</sub>(T)COR<sup>3</sup>,

15 R<sup>3</sup> is:

- (a) (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with phenyl;
- (b) phenyl or naphthyl optionally substituted with one, two, or three substituents selected from the group consisting of OCF<sub>3</sub>, O(CH<sub>3</sub>)<sub>3</sub>, CH<sub>3</sub>, CF<sub>3</sub> and halo;
- (c) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy; and
- (d) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of (C<sub>1</sub>-C<sub>6</sub>)-alkyl and (C<sub>1</sub>-C<sub>6</sub>)-alkoxy;

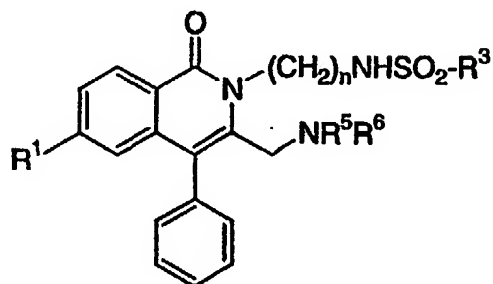
25

R<sup>5</sup> and R<sup>6</sup> are independently:

- (a) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (b) phenyl, and
- (c) (C<sub>1</sub>-C<sub>10</sub>)-alkyl optionally substituted with (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl; and

n is 1, 2, or 3.

Another preferred embodiment of the present invention is isoquinolinone compound of structural Formula Ig,



Ig

wherein  $R^1$ ,  $R^3$ ,  $R^5$ , and  $R^6$ , and n are as defined below:

$R^1$  is (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or halo,

wherein halo is fluoro, chloro, bromo, or iodo;

$R^3$  is:

- (a) (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with phenyl;
- (b) phenyl or naphthyl optionally substituted with one, two, or three substituents selected from the group consisting of OCF<sub>3</sub>, O(CH<sub>3</sub>)<sub>3</sub>, CH<sub>3</sub>, CF<sub>3</sub> and halo;
- (c) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy; and
- (d) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents of (C<sub>1</sub>-C<sub>6</sub>)-alkyl;

$R^5$  and  $R^6$  are independently:

- (a) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (b) phenyl, and
- (c) (C<sub>1</sub>-C<sub>10</sub>)-alkyl optionally substituted with (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl; and

n is 1, 2, or 3.

The compound of the present invention includes, but is not limited to: 3-dimethylaminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;

- 3-(2,3-dihydro-indol-1-ylmethyl)-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 3-[(ethyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 5 6-methoxy-2-methyl-4-phenyl-3-piperidin-1-ylmethyl-2H-isoquinolin-1-one;
- 3-[(*tert*-butyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 3-[(isopropyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 10 3-[(isopropyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 6-methoxy-2-methyl-4-phenyl-3-[(2,2,2-trifluoro-ethylamino)-methyl]-2H-isoquinolin-1-one;
- 2-(5-methoxy-2-methyl-1H-indol-3-yl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-acetamide;
- 15 N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-methanesulfonamide;
- butane-1-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide;
- 20 thiophene-2-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide;
- N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-benzenesulfonamide;
- furan-2-carboxylic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide;
- 25 N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-2-phenyl-acetamide hydrochloride;
- N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-nicotinamide;
- 30 9-methoxy-2-methyl-11-phenyl-1,2,3,4-tetrahydro-pyrazino[1,2-b]isoquinolin-6-one;
- 2-(1-acetyl-piperidin-4-ylmethyl)-3-dimethylaminomethyl-6-methoxy-4-phenyl-2H-isoquinolin-1-one;
- 3-dimethylaminomethyl-2-(1-methanesulfonyl-piperidin-4-ylmethyl)-6-methoxy-
- 35 4-phenyl-2H-isoquinolin-1-one;



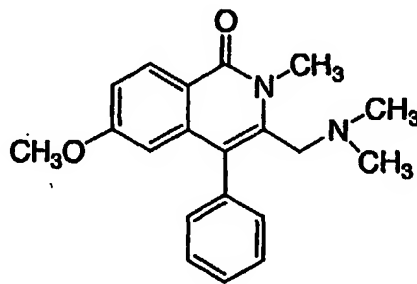
[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-carbamic acid *tert*-butyl ester;

N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-isonicotinamide; and

- 5 [2-(3-aminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-carbamic acid *tert*-butyl ester.

A preferred compound is a 3-dimethylaminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one or a pharmaceutically acceptable salt, hydrate, solvate, crystal form, or stereoisomer thereof as shown below:

10



- Also encompassed by the present invention is a method of treating a condition in a mammal, the treatment of which is effected or facilitated by  $K_v1.5$  inhibition or potassium current,  $I_{K_{UR}}$ , comprising the administration of a therapeutically effective amount of the compound of Formula I as recited above.

- Another embodiment of the present invention is a method of treating a condition in a mammal, the treatment of which is effected or facilitated by  $K_v1.5$  inhibition or  $I_{K_{UR}}$  current inhibition, comprising the administration of a therapeutically effective amount of pharmaceutical composition which comprises a pharmaceutical carrier and a compound of Formula I as recited above.

- A preferred embodiment of the present invention is a method of preventing or treating atrial arrhythmias in a mammal, comprising the administration of a therapeutically effective amount of the compound of Formula I as recited above.

- A more preferred embodiment of the present invention is a method of preventing or treating atrial arrhythmias in a mammal comprising a therapeutically effective amount of 3-dimethylaminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one or a pharmaceutically acceptable salt, hydrate, solvate, crystal form, and stereoisomer thereof.

The present invention also includes a pharmaceutical composition for the treatment of an atrial arrhythmia, comprising a pharmaceutically acceptable carrier and at least one compound of Formula I or its pharmaceutically acceptable salt, hydrate, solvate, crystal form, and stereoisomer thereof.

5           The present invention further includes a process for making a pharmaceutical composition comprising a compound of Formula I or its pharmaceutically acceptable salt, hydrate, solvate, crystal form, and stereoisomer thereof and a pharmaceutically acceptable carrier.

10           The compounds of the present invention include all of the pharmaceutically acceptable salts, hydrates, solvates, crystal forms, and stereoisomers of a compound of Formula I.

          As used herein, the term "alkyl," unless otherwise indicated, includes those alkyl groups of a designated number of carbon atoms of either a straight, branched, or cyclic configuration. Examples of "alkyl" include methyl, ethyl, propyl, isopropyl, butyl, *sec*-butyl, *tert*-butyl, pentyl, hexyl, heptyl, and the like. Examples of  
15           cycloalkyls are cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, norbornyl, 1,1,3,3-tetramethyl butyl, and the like.

          The term "alkenyl" includes hydrocarbon chains of a specified number of carbon atoms of either a straight or branched configuration and at least one  
20           unsaturation, which may occur at any point along the chain, such as ethenyl, propenyl, butenyl, pentenyl, and the like.

          Alkyl, cycloalkyl, and alkenyl can be optionally substituted with one, two, or three substituents as set forth in the embodiments recited above.

          The term "aryl," unless specifically defined otherwise, is defined as  
25           phenyl or naphthyl which may be optionally substituted with one, two or three of the substituents as set forth in the embodiments recited above.

          The term "alkoxy" represents an alkyl group of indicated number of carbon atoms attached through an oxygen bridge, such as methoxy, ethoxy, propoxy, isopropoxy, butoxy, *tert*-butoxy, pentoxy, and the like.

30           The term "heteroaryl" as utilized herein, unless specifically defined otherwise, is intended to include a monocyclic or bicyclic (fused) aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N and/or S, and the heterocyclyl being optionally substituted with one, two, or three substituents as set forth in the embodiments recited above. Heteroaryl groups within the scope of this  
35           definition include but are not limited to: acridinyl, carbazolyl, cinnolinyl,

quinoxaliny, pyrrazoly, indoly, benzotriazolyl, furanyl, thienyl, benzothienyl, benzofuranyl, quinoliny, isoquinoliny, pyraziny, pyridaziny, pyridiny, pyrimidiny, and pyrroly which are substituted or unsubstituted as defined above.

5           The term  $\text{NR}^5\text{R}^6$  in Q substituent means an amino group wherein  $\text{R}^5$  and  $\text{R}^6$  are independently selected from the group as set forth in the embodiments recited above. Optionally  $\text{R}^5$  or  $\text{R}^6$  can be joined with  $\text{R}^2$  substituent in Formula I to form a 5 to 8 atom heterocyclic ring, and the other of  $\text{R}^5$  or  $\text{R}^6$  is defined in the embodiment recited above.

10           "Heterocyclyl," unless specifically defined otherwise, is defined as a monocyclic or bicyclic ring of 5 to 14 carbon atoms which can be aromatic or nonaromatic, and may contain 1 to 4 heteroatoms selected from N, O, and S, which is optionally substituted with one, two, or three substituents as set forth in the embodiments recited above.

15           When Q is defined as  $\text{NH}(\text{C}=\text{O})\text{R}^7$  and  $\text{R}^7$  is defined as set forth in the embodiments recited above.

20           The heterocyclyl groups within the scope of this definition include but are not limited to: pyrrolidiny, piperaziny, morpholiny, 1,4-dioxo-8-aza-spiro[4, 5]decyl, piperidiny, 2,3-dihydroindolyl, indolyl, dithiolanyl, oxo-hexahydro-thieno[3,4-d]imidazolyl, thiophenyl, benzoimidazol, dioxo-2,5-dihydro-pyrroly, 6-methoxy-3-oxo-ndanyl, 6-chloro-9H-carbazoyl, 5-fluoro-1H-indolyl, quinoxaliny, 5-methoxy-2-methyl-1H-indolyl, thiophene, 1-methyl-1H-imidazol, 3,5-dimethyl-isoxazole, quinoline, furan, 1, 2, 3, 4-tetrahydro-pyrazino, and piperidiny.

25           In the compounds of Formula I, the heteroaryl, heterocyclyl or aryl groups may be optionally substituted with the substituents listed above at any available carbon atom or heteroatom. The heterocyclyl may also be spiro or fused to a second 5-, 6-, or 7-membered ring containing one or two oxygens such as: dioxolanyl, dihydrofuranyl, dihydropyranyl, and dioxanyl. Disubstituted aryl groups may be ortho, para or meta and all three are intended unless specifically defined otherwise.

30           Pharmaceutically acceptable salts include both the metallic (inorganic) salts and organic salts; a list of which is given in *Remington's Pharmaceutical Sciences*, 17th Edition, p.1418 (1985). It is well known to one skilled in the art that an appropriate salt form is chosen based on physical and chemical stability, flowability, hygroscopicity and solubility. As will be understood by those skilled in the art, pharmaceutically acceptable salts include, but are not limited to salts of  
35           inorganic acids such as hydrochloride, sulfate, phosphate, diphosphate, hydrobromide,

and nitrate or salts of an organic acid such as malate, maleate, fumarate, tartrate, succinate, citrate, acetate, lactate, methanesulfonate, p-toluenesulfonate or palmoate, salicylate and stearate. Similarly pharmaceutically acceptable cations include, but are not limited to sodium, potassium, calcium, aluminum, lithium and ammonium  
5 (especially ammonium salts with secondary amines). Also included within the scope of this invention are crystal forms, hydrates and solvates of the compounds of Formula I.

The term aprotic solvent means a type of solvent which neither donates nor accepts protons. An aprotic solvent includes, but not limited to: tetrahydrofuran  
10 (THF), acetonitrile, dimethylformamide (DMF), dimethylacetamide (DMA), N-methylpyrrolidinone (NMP), diethyl ether, dichloromethane, chloroform, ethyl acetate, pentane, hexane, toluene, benzene, chlorobenzene, methyl *tert*-butyl ether (MTBE) and mixtures thereof.

The term "treating" as used herein refers to the management and care  
15 of a mammal afflicted with a condition or disorder for which the administration of a compound in accordance with the present invention alters the action or activity of a potassium channel or potassium current to prevent the onset of symptoms or complications caused by the condition or disorder, or to eliminate the condition or disorder altogether.

For the purpose of this disclosure, a mammal is a member of the  
20 animal kingdom possessed of a homeostatic mechanism which includes human and birds.

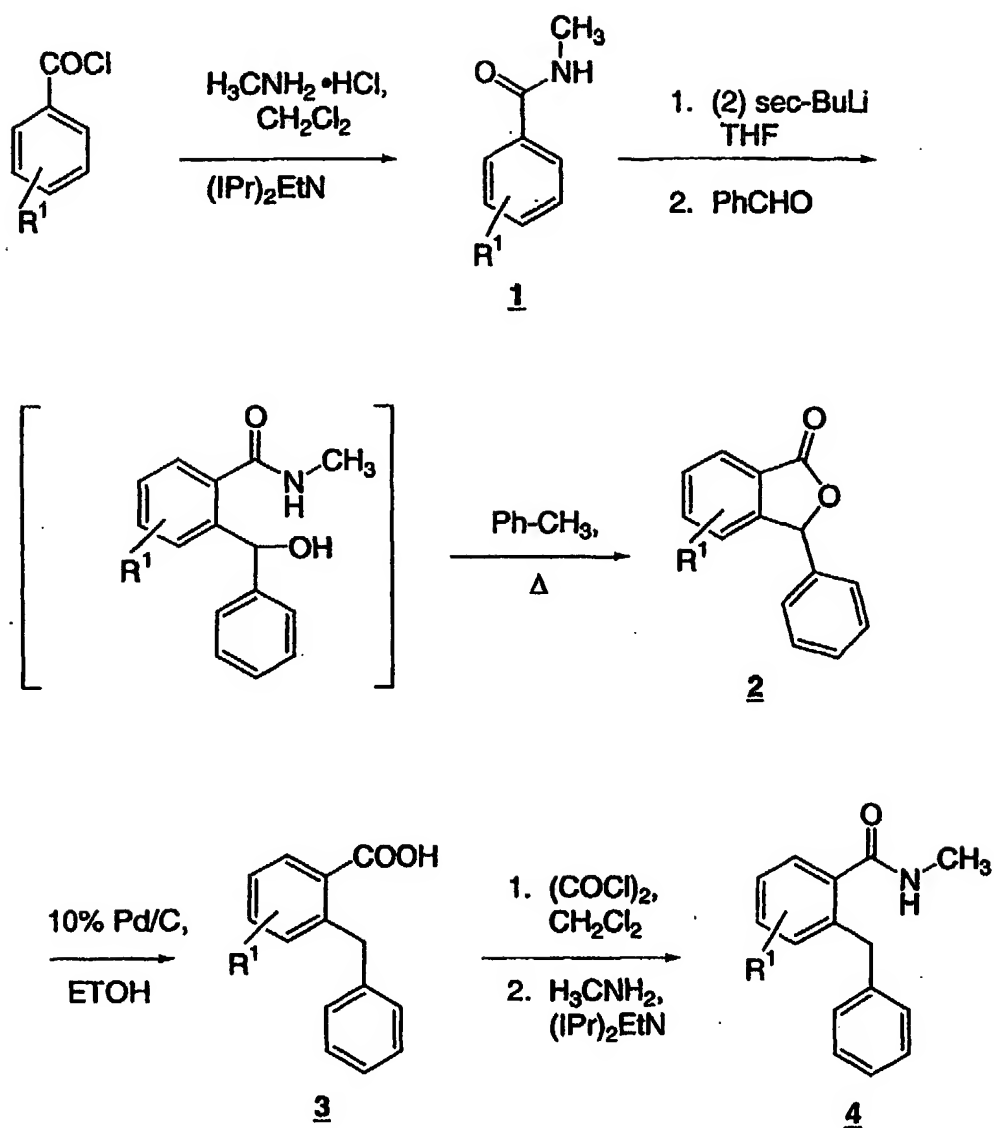
The dosage administered will be dependent on the age, health and weight of the recipient, the extent of disease, kind of concurrent treatment, if any,  
25 frequency of treatment and the nature of the effect desired. In the method of treating arrhythmia of the present invention, a compound or pharmaceutically acceptable salt thereof, is administered in an amount ranging from about 0.01 to about 50 mg per kg of body weight per day, preferably from about 0.10 to about 30 mg per kg of body weight per day in a single dose or in 2 to 4 divided doses.

The compounds of the present invention can be administered as the sole active ingredient or in combination with other antiarrhythmic agents or other cardiovascular agents such as but are not limited to ACE inhibitors, angiotensin II  
30 antagonist, selective and nonselective beta blockers, endothelin antagonist, thrombin inhibitors, aspirin, warfarin, and factor Xa inhibitors. The compounds, or  
35 pharmaceutically acceptable salts thereof, of the present invention, in the described

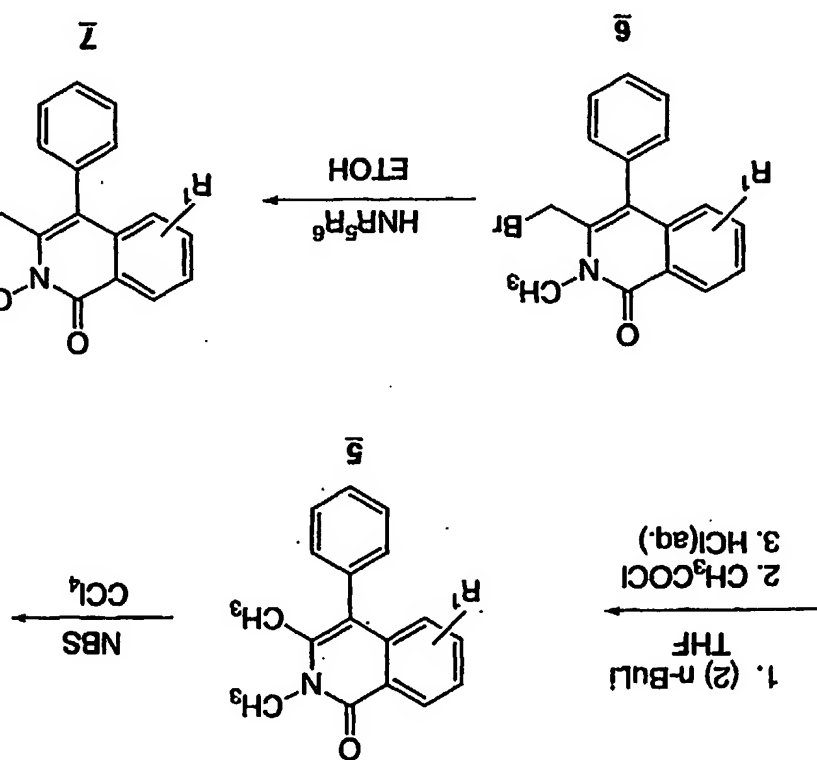
dosages, are administered orally, intraperitoneally, subcutaneously, intramuscularly, transdermally, sublingually or intravenously. They are preferably administered orally, for example in the form of tablets, troches, capsules, elixirs, suspensions, syrups, wafers, chewing gum, or the like prepared by art recognized procedures. The amount  
5 of active compound in such therapeutically useful compositions or preparations is such that a suitable dosage will be obtained.

Methods for preparing the compounds of the present invention are illustrated in the following schemes and examples. Other synthetic routes would be readily apparent to those skilled in the art.

## REACTION SCHEME A



## REACTION SCHEME A (CONTINUED)



5 In Reaction Scheme A, treatment of anisoyl chloride with methylamine

hydrochloride and diisopropylethylamine in aprotic organic solvent gave amide (1).

Reaction with a base in aprotic solvent followed by addition of benzaldehyde afforded

alcohol. Refluxing in toluene gave the lactone (2) which was then converted to the

carboxylic acid (3) by catalytic hydrogenation. Treatment of the acid (3) with oxaly

chloride followed by reaction with methylamine gave the N-methylamide (4). The

dianion of the compound (4) was prepared by using a base, and reaction with acetyl

chloride gave the key intermediate cyclized product (5), which was further

halogenated to give bromomethyl compound (6). The nucleophilic displacement of

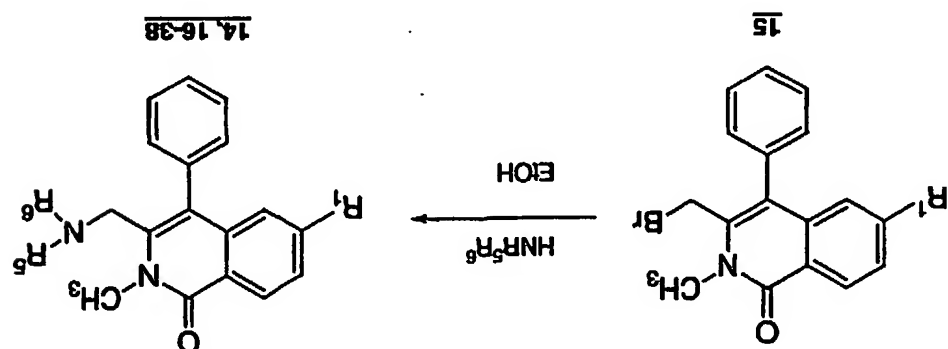
halogen with an amine afforded the final product if aminomethyl compound (7).

Table 1 below provides the compounds that were prepared in accordance with

Reaction Scheme A.


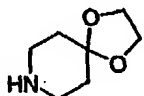

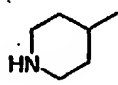
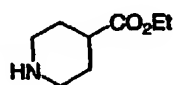
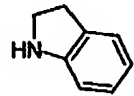
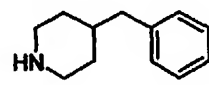

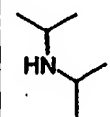
Table 1: Reaction of 15 With HNR<sub>5</sub>R<sub>6</sub> to Compounds Give Compounds 14 and


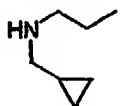



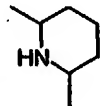

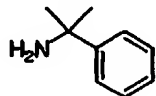
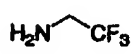
16-38



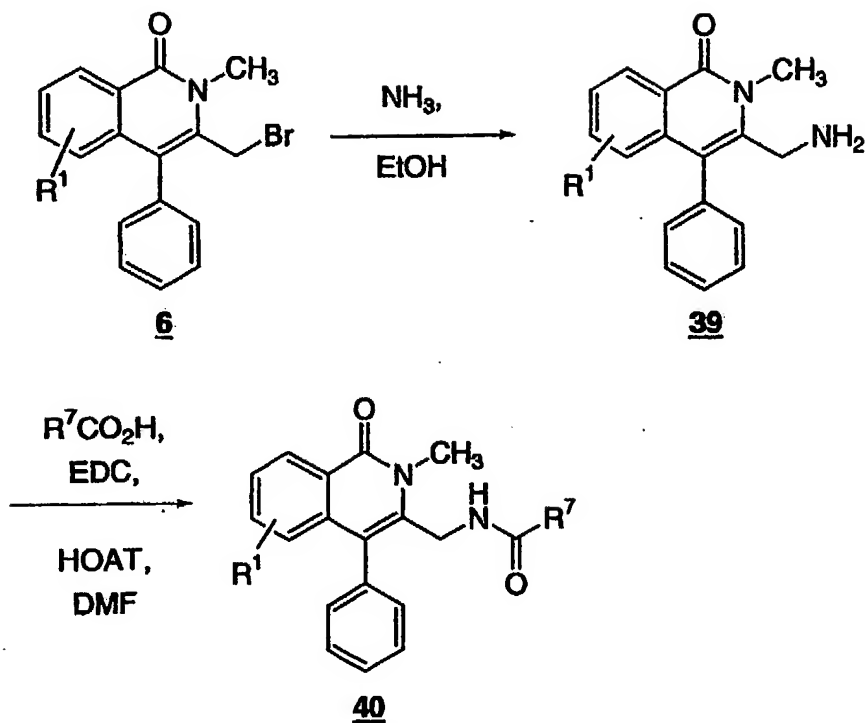
NO.	Compound Name	R <sup>1</sup>	HNR <sup>5</sup> R <sup>6</sup>	MS [M+H] <sup>+</sup>	Salt Form
14	3-Dimethylamino-6-methoxy-2-methyl-4-phenyl-2H-isquinolin-1-one	OCH <sub>3</sub>	HN(CH <sub>3</sub> ) <sub>2</sub>	323	-HCl
16	2-Methyl-4-phenyl-3-pyrrolidin-1-ylmethyl-2H-isquinolin-1-one	H		319.2	free base
17	3-(Isobutylamino-methyl)-2-methyl-4-phenyl-2H-isquinolin-1-one	H		321.2	free base
18	3-[(3-Methoxy-propylamino)-methyl]-2-methyl-4-phenyl-2H-isquinolin-1-one	H		337.2	-HCl
19	2-Methyl-3-(4-methyl-piperazin-1-ylmethyl)-4-phenyl-2H-isquinolin-1-one	H		348.2	free base
20	3-Imidazol-1-ylmethyl-2-methyl-4-phenyl-2H-isquinolin-1-one	H		312.2	free base



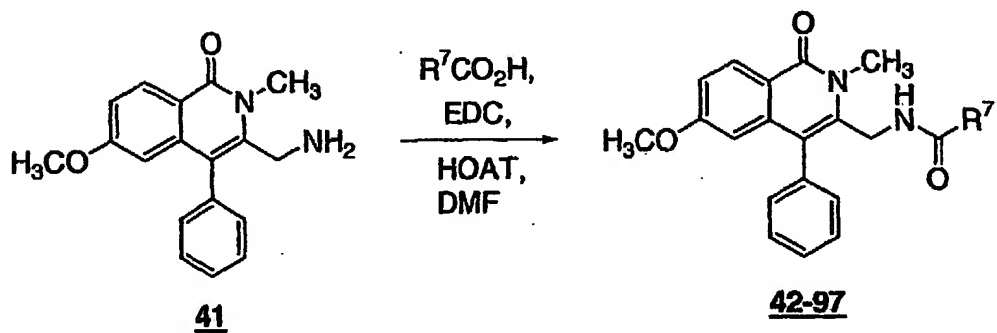
21	2-Methyl-3-morpholin-4-ylmethyl-4-phenyl-2H-isoquinolin-1-one	H		335	free base
22	3-(1,4-Dioxo-8-aza-spiro[4.5]dec-8-ylmethyl)-2-methyl-4-phenyl-2H-isoquinolin-1-one	H		391	free base
23	2-Methyl-4-phenyl-3-piperidin-1-ylmethyl-2H-isoquinolin-1-one	H		333	free base
24	6-Methoxy-2-methyl-3-(4-methyl-piperidin-1-ylmethyl)-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		377	free base
25	1-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-piperidine-4-carboxylic acid	OCH <sub>3</sub>		435	•HCl
26	3-(2,3-Dihydro-indol-1-ylmethyl)-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		397	free base
27	3-(4-Benzyl-piperidin-1-ylmethyl)-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		453	•HCl
28	6-Methoxy-2-methyl-4-phenyl-3-piperidin-1-ylmethyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		363	free base
29	3-[(Diisopropylamino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		379.2	free base

30	3-[(tert-Butyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		365.34	free base
31	3-[(Cyclopropylmethyl-propyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		391	free base
32	3-[(Ethyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		337.32	free base
33	6-Methoxy-2-methyl-3-methylaminomethyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		309.31	free base
34	3-[(Isopropyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		351.34	free base
35	3-(2,6-Dimethyl-piperidin-1-ylmethyl)-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		391.2	free base
36	6-Methoxy-2-methyl-4-phenyl-3-[(1,1,3,3-tetramethyl-butylamino)-methyl]-2H-isoquinolin-1-one	OCH <sub>3</sub>		407.2	free base
37	6-Methoxy-2-methyl-3-[(1-methyl-1-phenyl-ethyl-amino)-methyl]-4-phenyl-2H-isoquinolin-1-one	OCH <sub>3</sub>		413.1	free base
38	6-Methoxy-2-methyl-4-phenyl-3-[(2,2,2-trifluoro-ethyl-amino)-methyl]-2H-isoquinolin-1-one	OCH <sub>3</sub>		377.2	•HCl

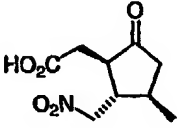
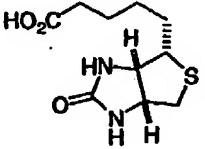

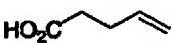
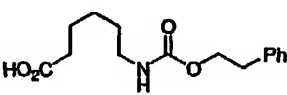
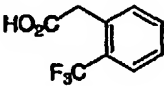
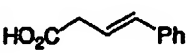
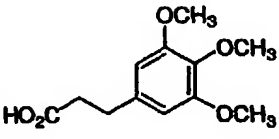
## REACTION SCHEME B

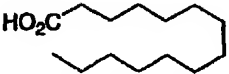

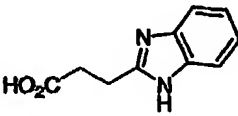
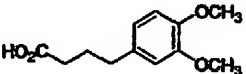
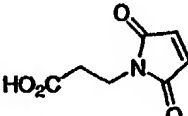
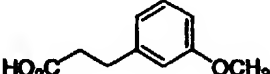
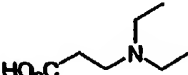
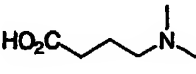
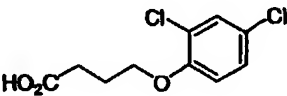


- 5                      In Reaction Scheme B, a bromomethyl compound (6) was prepared as described in Reaction Scheme A. The treatment of primary amine (39), which was prepared by alkylation of an amine or ammonia, with a carboxylic acid and ethylcarbodiimide (EDC) in aprotic solvent afforded the compound (40). Table 2 below provides the compounds that were prepared in accordance with Reaction
- 10      Scheme B.

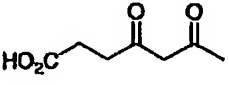
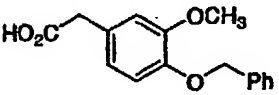
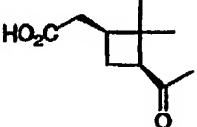
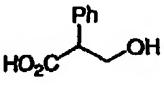
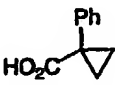
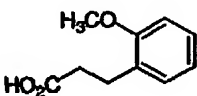
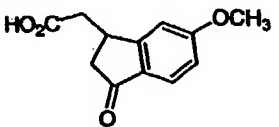
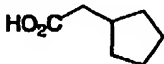
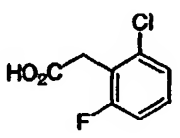
**Table 2: Reaction of 41 With Carboxylic Acids to Give Compounds 42-97**

No.	Compound Name	R <sup>7</sup> CO <sub>2</sub> H	MS [M + H] <sup>+</sup>	Salt Form
42	5-Phenyl-pentanoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		455.4	free base
43	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-o-tolyl-propionamide		441.3	free base
44	3-(R)-7-Dimethyl-oct-6-enoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		447.3	free base
45	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-2-(2-methyl-1H-indol-3-ylmethyl)-acetamide		345.3	free base
46	5-[1,2]Dithiolan-3-yl-pentanoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		483.3	free base

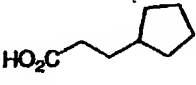
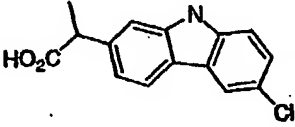
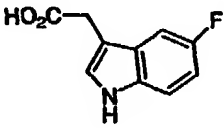
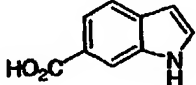

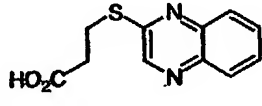
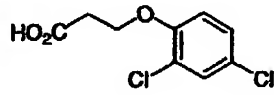
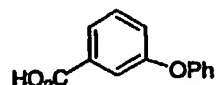
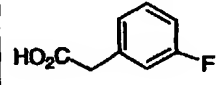
47	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-2-[(1 <i>R</i> )-(2 <i>S</i> )-(3 <i>R</i> )]-(3-methyl-2-nitromethyl-5-oxo-cyclopentyl)-acetamide		492.3	free base
48	5-(2-Oxo-hexahydro-thieno[3,4-d]imidazol-6-yl)-pentanoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		521.4	free base
49	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-4-thiophen-2-yl-butyramide		447.3	free base
50	Pent-4-enoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		377.3	free base
51	[5-[(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-carbamoyl]-pentyl]carbamic acid phenethyl ester		542.4	free base
52	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-2-(2-trifluoromethyl-phenyl)-acetamide		481.3	free base
53	4-Phenyl-but-3-enoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		439.3	free base
54	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-(3,4,5-trimethoxy-phenyl)-propionamide		517.5	free base

55	Tetradecanoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		505.6	free base
56	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-nitro-propionamide		396.3	free base
57	3-(1H-Benzoimidazol-2-yl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-propionamide		467.4	free base
58	4-(3,4-Dimethoxy-phenyl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-butyramide		501.5	free base
59	3-(2,5-Dioxo-2,5-dihydro-pyrrol-1-yl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-propionamide		446.3	free base
60	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-(3-methoxy-phenyl)-propionamide		457.4	free base
61	Diethylamino-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-propionamide		422.4	free base
62	Dimethylamino-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-butyramide		408.4	free base
63	4-(2,4-Dichloro-phenoxy)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-butyramide		525.4	free base

64	4,4-Bis-(4-hydroxy-phenyl)-pentanoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		563.3	free base
65	4-Cyclohexyl-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-butyramide		447.4	free base
66	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-p-tolylsulfanyl-propionamide		473.4	free base
67	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-o-tolylsulfanyl-propionamide		473.4	free base
68	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-(naphthalen-1-ylsulfanyl)-propionamide		509.5	free base
69	4-(4-Fluoro-phenyl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-4-oxo-butyramide		473.3	free base
70	Hex-3-enoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		391.3	free base
71	Acetic acid 1-[(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-carbamoyl]-1-(R)-phenyl-methyl ester		471.3	free base
72	2-(R)-Methoxy-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-2-phenyl-acetamide		443.3	free base

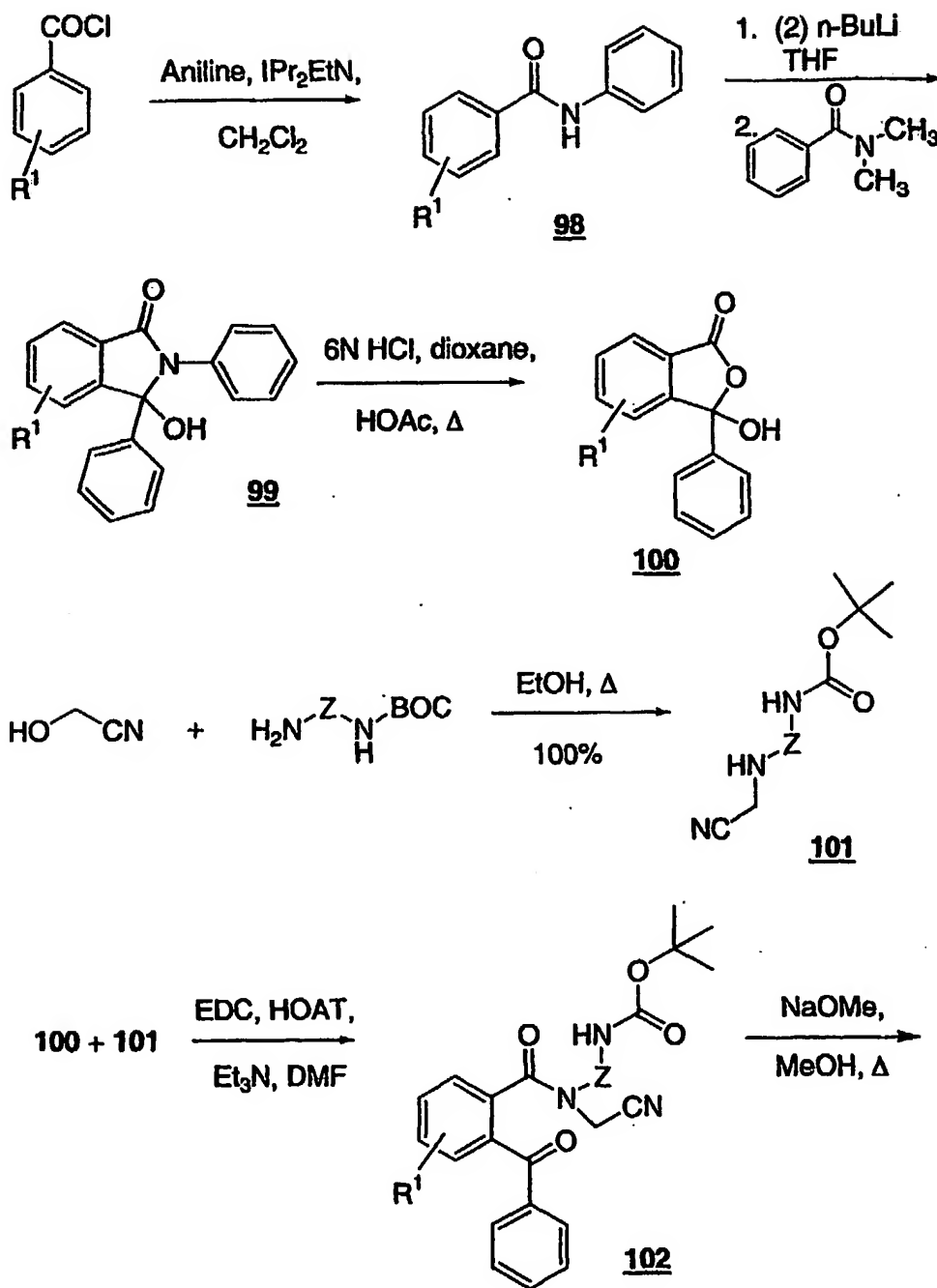
73	4,6-Dioxo-heptanoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		435.3	free base
74	2-(4-Benzyloxy-3-methoxy-phenyl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-yl)-acetamide		549.4	free base
75	cis-2-(3-Acetyl-2,2-dimethyl-cyclobutyl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-yl)-acetamide		461.4	free base
76	3-Hydroxy-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-2-phenyl-propionamide		443.3	free base
77	1-Phenyl-cyclopropanecarboxylic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-yl)-amide		439.3	free base
78	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-(2-methoxy-phenyl)-propanamide		457.4	free base
79	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-2-(6-methoxy-3-oxo-ndan-1-yl)-acetamide		497.4	free base
80	2-Cyclopentyl-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-acetamide		403.3	free base
81	2-(2-Chloro-6-fluoro-phenyl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-acetamide		465.3	free base



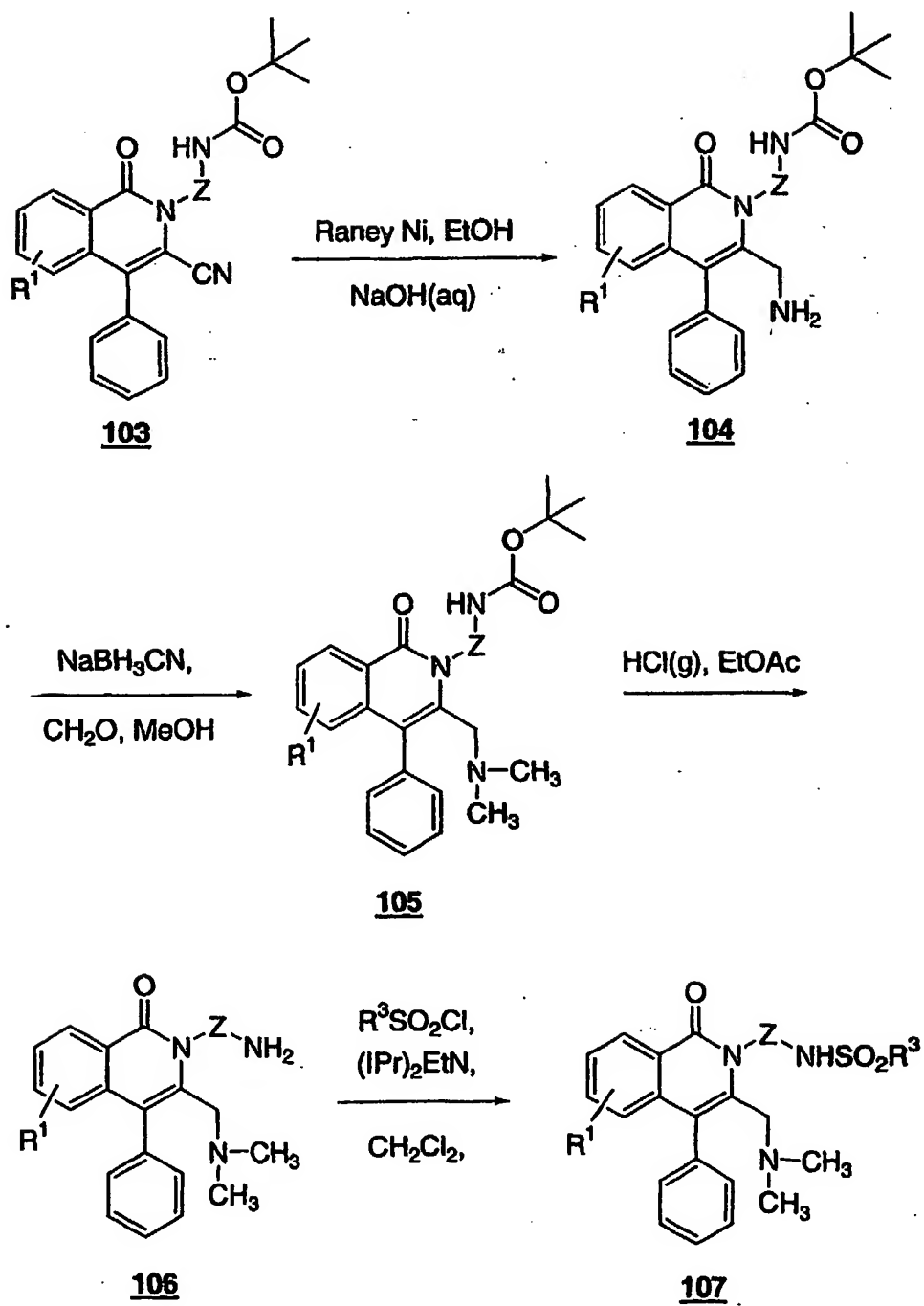
82	3-Cyclopentyl-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-propionamide		419.4	free base
83	2-(6-Chloro-9H-carbazol-2-yl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-2-methyl-acetamide		550.3	free base
84	2-(5-Fluoro-1H-indol-3-yl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-acetamide		470.3	free base
85	1H-Indole-6-carboxylic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		438.3	free base
86	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-phenylsulfanyl-propionamide		459.3	free base
87	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-quinoxalin-2-ylsulfanyl)-propionamide		511.4	free base
88	3-(2,4-Dichloro-phenoxy)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-propionamide		511.4	free base
89	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-3-phenoxy-benzamide		491.4	free base
90	2-(3-Fluoro-phenyl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-acetamide		431.3	free base

91	4'-Trifluoromethyl-biphenyl-2-carboxylic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		543.4	free base
92	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-4-phenoxy-benzamide		491.4	free base
93	N-(6-Methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-2-(4-methoxy-phenyl)-2-phenoxy-acetamide		535.4	free base
94	2-Benzyl-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-benzamide		489.4	free base
95	Biphenyl-2-carboxylic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		475.4	free base
96	Biphenyl-3-carboxylic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide		475.3	free base
97	2-(5-Methoxy-2-methyl-1H-indol-3-yl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-acetamide		496.4	free base

## REACTION SCHEME C

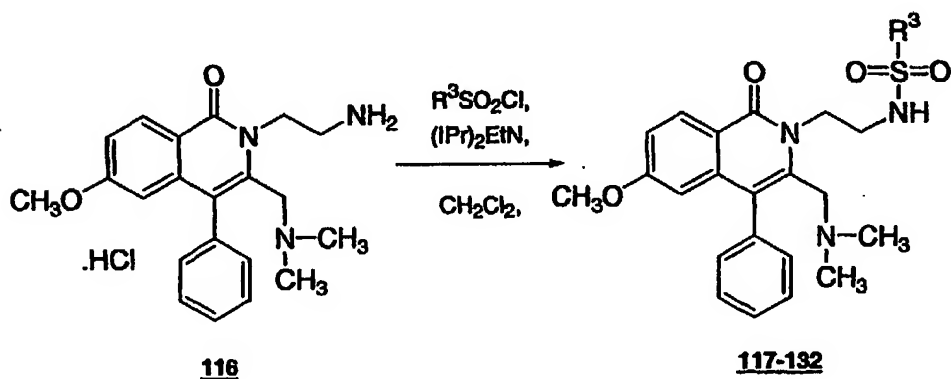


## REACTION SCHEME C (CONTINUED)


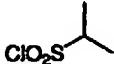
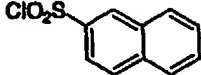
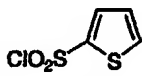
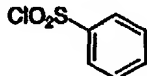
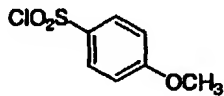
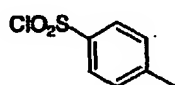
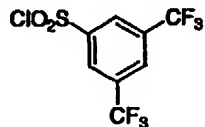
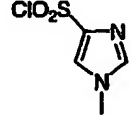


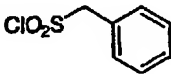
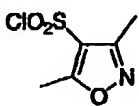
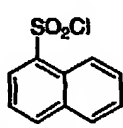
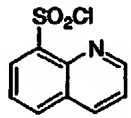
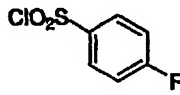
In Reaction Scheme C, compound 99 was prepared in the same way as described in Reaction Scheme A. The compound 100 was produced by a hydrolysis followed by hemiketal formation. The compound 100 then reacted with compound 101 to form amide compound of 102, which is then cyclized in the presence of base to form compound 103. The nitrile reduction of compound 103 gave compound 104, which undergoes reductive alkylation to give compound 105. The removal of protecting group (BOC) in compound 105 afforded 106, which is then reacted with sulfonyl chloride to give the final product of sulfonamide compound 107. Table 3 below provides the compounds that were prepared in accordance with Reaction Scheme C.

**Table 3: Reaction of 116 With Sulfonyl Chlorides to Give Sulfonamide Compounds 118-132**



No.	Name	$\text{R}^3\text{SO}_2\text{Cl}$	MS [M + H] <sup>+</sup>	Salt Form
117	N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-methanesulfonamide	$\text{CH}_3\text{SO}_2\text{Cl}$	430.3	free base
118	N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-2-trifluoromethoxy-benzenesulfonamide		576.3	free base

119	Butane-1-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide		472	free base
120	Propane-2-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide		458	free base
121	Naphthalene-2-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide		542.6	free base
122	Thiophene-2-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide		498.3	free base
123	N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-benzenesulfonamide		492.3	free base
124	N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-4-methoxy-benzenesulfonamide		522.3	free base
125	N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-4-methyl-benzenesulfonamide		506.3	free base
126	N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-bis-3,5-(trifluoromethyl)-benzenesulfonamide		628	free base
127	1-Methyl-1H-imidazole-4-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide		496.3	free base

128	N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-1-phenyl-methanesulfonamide		506.3	free base
129	3,5-Dimethyl-isoxazole-4-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide		511.3	free base
130	Naphthalene-1-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide		542.2	free base
131	Quinoline-8-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide		543.1	free base
132	N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-4-fluoro-benzenesulfonamide		510.1	free base

The specificity and utility of the exemplified compound as antiarrhythmic agent is shown by the following voltage-clamp studies in CHO cells expressing human  $K_v1.5$  and in isolated human atrial myocytes and guinea pig isolated ventricular myocytes in vitro. Assays for assessing the activity of particular compounds may employ cells stably transfected to express a specific potassium channel as well as native mammalian cells. For example, cells stably transfected to express a specific potassium channel, which have been treated with a voltage dependent fluorescent dye, can be used to gauge the inhibitory activity of potassium channel inhibitor compounds, possibly in comparison to known inhibitors. Alternatively, such cells can be primed with a detectable species, such as  $^{86}\text{Rb}$ , and then challenged with a particular compound, under conditions otherwise suitable for activating potassium channel, to assess the potassium inhibitory activity of the compound. The potassium channel inhibitory activity of a compound also can be determined using isolated mammalian cells and the whole cell configuration of the known patch clamp technique (Hamill et al., *Pflugers Archiv* 391:85, 1981). These and other known techniques can be readily employed by those skilled in the art to

assess the activity level of the potassium channel inhibitor compounds contemplated by the present invention.

## VOLTAGE CLAMP MEASUREMENT OF IONIC CURRENTS IN VITRO

5

### A. Measurement of K<sub>v</sub>1.5 in CHO cells

#### Expression of K<sub>v</sub>1.5 in CHO Cells

A cDNA encoding K<sub>v</sub>1.5, isolated from a human fetal heart library,  
10 was subcloned into pcDNAI/Neo (Invitrogen) as a Hind III–Xba I fragment.  
CHO KI cells were plated at  $2.7 \times 10^4$  cells/60 mm dish and incubated  
at 37°C in a 5% CO<sub>2</sub> environment for three days. Cells were then washed twice and  
covered with 3 ml of OptiMEM medium (Gibco). Plasmid/DOTAP solution  
(consisting of 5 mg of K<sub>v</sub>1.5 in pcDNAI/Neo and 30 mg DOTAP transfection reagent  
15 (Boehringer Mannheim) in 1 ml of OptiMEM) was added dropwise to each plate  
while swirling. Plates were incubated overnight and the media then changed to 5 mls  
of F12 (Gibco) supplemented with 10% FBS (Sigma), 1,000 U/ml penicillin 1,000  
mg/ml streptomycin (Gibco), and 2 mM glutamine (Gibco). After two more days, the  
cells were trypsinized and replated on 100 mm dishes in supplemented F12 media  
20 including 1 mg/ml G418 (Gibco). The medium was changed daily until  
nontransfected cells were killed. Cell lines were grown from individual clones and  
tested for expression of K<sub>v</sub>1.5 using both the <sup>86</sup>Rb efflux assay and voltage clamp  
protocols. Lines exhibiting the highest level of expression were then recloned by  
serial dilution. These cells were maintained in culture and on each experimental day  
25 were freshly isolated by mild trypsinization.

#### Voltage Clamp Technique:

CHO cells plated on glass coverslips were placed in a 1-ml chamber  
mounted on the stage of an inverted microscope, and perfused at 2-3 ml/min with the  
30 following solution (in mM/L): 132 NaCl, 4 KCl, 1.2 MgCl<sub>2</sub>, 10 HEPES (formal name:  
N-2-hydroxyethyl piperazine-N'-2-ethanesulfonic acid), 11.1 glucose. CaCl<sub>2</sub> (0.5-1.8  
mM) was present in some experiments, and had no effects on K<sub>v</sub>1.5. Nisoldipine (0.4  
mM-1.0 mM), a relatively specific blocker of L-type Ca<sup>2+</sup> channels was present in all  
experiments. The patch-clamp technique was used to record ionic currents in the  
35 whole-cell configuration. Patch pipettes were obtained using a two stage puller from



square bore (1.0 mm o.d.) borosilicate capillary tubing. Pipettes were filled with the following solution (in mM/L): 110 K-Gluconate or K-Aspartate, 20 KCl, 5 MgATP, 5 EGTA, 5-10 HEPES, pH 7.2. The electrodes had tip resistances ranging from 3 to 10 Mohm when filled with this solution. Following seal formation, the membrane was ruptured by gentle suction to establish the whole-cell configuration, and negative pressure was maintained on the pipette using a 1 ml gas-tight syringe attached via air tight tubing to the suction port of the microelectrode holder. Series resistance was compensated 70-85%. Currents were sampled at 5 kHz using an Axopatch 200 A amplifier (Axon Instruments) or a List EPC-7 clamp amplifier (List Electronic) and were low pass filtered at 1 kHz. Data acquisition and analysis were performed using pClamp software (Axon Instruments) and an IBM compatible 486 computer.

#### Measurements of $K_v1.5$ Expressed Currents:

$K_v1.5$  currents were elicited by 150 ms depolarizing test pulses to +40 mV from a holding potential of -80 mV. The effects of test agents were assessed at steady state. Data was analyzed as % block from control current amplitude. The amplitude of  $K_v1.5$  was measured as the amplitude of the time-dependent net outward current at the end of the test pulse, relative to the holding current level.  $IC_{50}$  for rested state and use-dependent block were determined from the first and tenth pulses, respectively, during a series of 10 consecutive pulses delivered at 1 Hz. All experiments were performed at room temperature (22-24 °C).

#### B. Measurement of $I_{Kur}$ in Human Atrial Myocytes

##### Isolation of Human Atrial Myocytes:

Human myocytes were isolated from specimens of right atrial appendage obtained from patients undergoing cardiopulmonary bypass, using a modification of the procedure described by Ferrini, B., Wang, Z., Duan, D. and Nattel, S., "Differences in rate dependence of transient outward current in rabbit and human atrium" *Am. J. Physiol.* 263:H1747- H1754 (1992). All tissues were collected in accordance with Temple University School of Medicine Institutional guidelines. All atrial specimens were grossly normal at the time of excision. Tissue samples were quickly immersed in cold (0-4 °C) cardioplegia solution containing (in mM/L): 50KH<sub>2</sub>PO<sub>4</sub>, 8MgSO<sub>4</sub>, 10NaHCO<sub>3</sub>, 5 adenosine, 25 taurine, 140 glucose, and 100 mannitol, pH 7.4 and bubbled with 100% O<sub>2</sub>. Specimens were minced into 0.5-1 mm cubes and transferred to a 50-ml conical tube containing an ultra low calcium wash

solution containing (in mM/L): 137 NaCl, 5  $\text{KH}_2\text{PO}_4$ , 1  $\text{MgSO}_4$ , 10 taurine, 10 glucose, 5 HEPES and 0.1 EGTA (formal name: Ethyleneglycol-bis-(b-aminoethyl ether) N,N,N',N'-tetraacetic acid), pH 7.4 (22-24 °C). The tissue was gently agitated by continuous bubbling with 100%  $\text{O}_2$  for 5 min. The tissue was then incubated in 5 ml of solution containing (in mM/L): 137 NaCl, 5  $\text{KH}_2\text{PO}_4$ , 1  $\text{MgSO}_4$ , 10 taurine, 10 glucose, and 5 HEPES supplemented with 0.1% bovine albumin, 1.5 mg/ml collagenase CLS II (Worthington Biochemical), and 1.0 mg/ml protease type XXIV (Sigma Chemical Co.), pH 7.4 (37 °C), and bubbled continuously with 100%  $\text{O}_2$ . The supernatant was removed after 40 min and discarded. The chunks were then incubated in a solution of the same ionic composition but supplemented with only collagenase and 100 mM  $\text{CaCl}_2$ . Microscopic examination of the medium was performed every 10-20 min to determine the number and quality of isolated cells. When the yield appeared maximal, the tissue chunks were suspended in a modified Kraftbrue solution containing (in mM/L): 25 KCl, 10  $\text{KH}_2\text{PO}_4$ , 25 taurine, 0.5 EGTA, 22 glucose, 55 glutamic acid, and 0.1% bovine albumin, pH 7.3 (22-24 °C) and gently triturated using a large bore Pasteur pipette. The supernatant was collected in a 50 ml centrifuge tube. The cell suspension was centrifuged for 2 min at 1000 rpm and the resulting pellet was resuspended in 0.2 mM HBS solution containing (in mM/L): 132 NaCl, 4 KCl, 1.2  $\text{MgCl}_2$ , 10 HEPES and 11.1 glucose, pH 7.2. Cells were used within 2-24 hr after isolation.

#### Voltage-clamp technique:

A small aliquot of the solution containing the isolated human atrial myocytes was placed in a 1-ml chamber mounted on the stage of an inverted microscope. Five minutes were allowed for cell adhesion to the bottom of the chamber. To record  $I_{\text{Kur}}$ , human atrial myocytes were superfused with a solution of the same ionic composition as that used for  $\text{K}_v1.5$ . An alternative external solution was sometimes used in which NaCl was replaced with NMDG (formal name: N-methyl-d-glucamine) to inhibit  $I_{\text{Na}}$ . NMDG had no effects on  $I_{\text{Kur}}$  and there were no notable quantitative differences in the degree of block of  $I_{\text{Kur}}$  with these two conditions.

Currents were elicited by 150 ms depolarizing test pulses to +40 mV from a holding potential of -50 mV to inactivate  $I_{\text{to}}$  and  $I_{\text{Na}}$ . The amplitude of  $I_{\text{Kur}}$  was measured as the amplitude of the time-dependent current at the end of the test pulse, relative to the holding current level. Similar to  $\text{K}_v1.5$ , the effects of all drugs were

studied only when steady-state changes were achieved and data was analyzed as %  
block from control currents.  $IC_{50}$  for rested state and use-dependent block was  
determined from the first and tenth pulses, respectively, during a series of 10  
consecutive pulses delivered at 1 Hz. All experiments were performed at room  
5 temperature (22-24 °C).

#### C. Measurement of Use-Dependent and Rate-Dependent Block.

Use-dependent and rate-dependent block were assessed by measuring the currents  
elicited during trains of 150 msec long depolarizing pulses to a test potential of +40  
10 mV from holding potentials of -80 mV and -50 mV in CHO cells and human atrial  
myocytes, respectively. Pulses were applied in 10 second long trains delivered after 30  
second rest intervals at frequencies of 1 Hz (10 pulses) or 3 Hz (30 pulses). Percent  
block of the current is defined as the % decrease in the current amplitude produced by  
an agent during a given pulse relative to the control current amplitude for that pulse.  
15 Rested-state block is the block of the current during the first pulse in a train following  
the 30 second rest period. Use dependent block is block that occurs to a progressively  
greater extent with each successive depolarization in a train or sequence of pulses or  
depolarizations delivered at a given rate or frequency. Thus, during a train of 10  
depolarizations at frequency of 1 Hz, use-dependent block is assessed as the ratio of  
20 the amount of block for the 10th pulse relative to block for the 1st pulse (rested state  
block) of the train. Rate-dependent block is block that occurs to a greater extent or  
preferentially at faster rates of depolarization or heart rates. Thus, rate-dependent  
block is assessed as the ratio of the amount of block of the current during the last  
pulse of the 10 second train at 3 Hz vs. 1 Hz. Consequently, ratios of less than one (<  
25 1) are indicative of use-dependent and rate-dependent block and the lower the ratio  
the greater the degree of use and rate dependence.

While the invention has been described and illustrated with reference  
to certain particular embodiments thereof, those skilled in the art will appreciate that  
various adaptations, changes, modifications, substitutions, deletions, or additions of  
30 procedures and protocols may be made without departing from the spirit and the scope  
of the invention. For example, effective dosages other than the particular dosages as  
set forth herein above may be applicable as a consequence of variations in the  
responsiveness of the mammal being treated for any of the indications with the  
compounds of the invention indicated above. Likewise, the specific pharmacological  
35 responses observed may vary according to and depending upon the particular active

compounds selected for whether there are present pharmaceutical carriers, as well as the type of formulation and mode of administration employed, and such expected variations or differences in the results are contemplated in accordance with the objects and practices of the present invention. It is intended therefore, that the invention be  
5 defined by the scope of the claims and that such claims be interpreted as broadly as is reasonable.

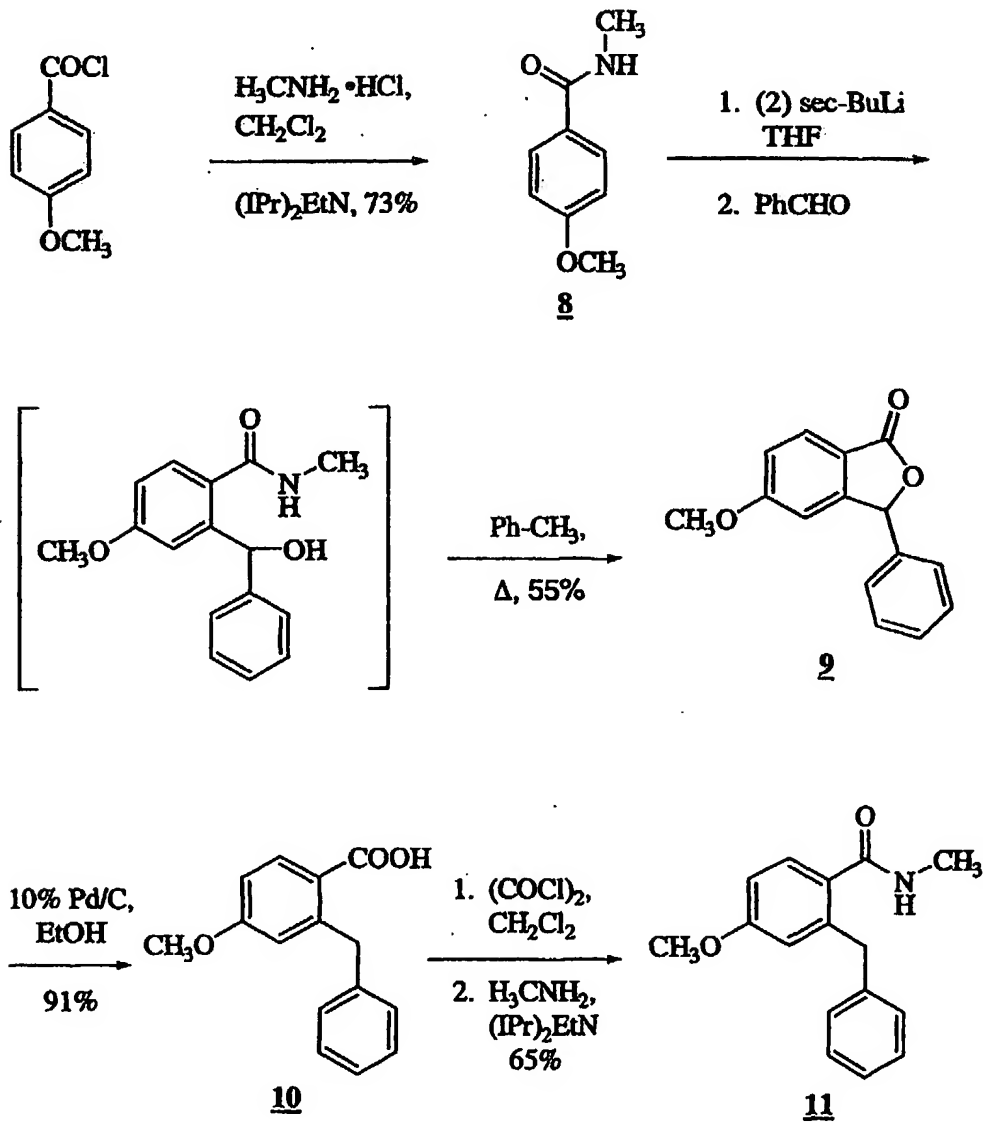
The following examples illustrate the preparation of the compounds of Formula I and as such are not to be considered as limiting the invention set forth in the claims appended hereto.

10

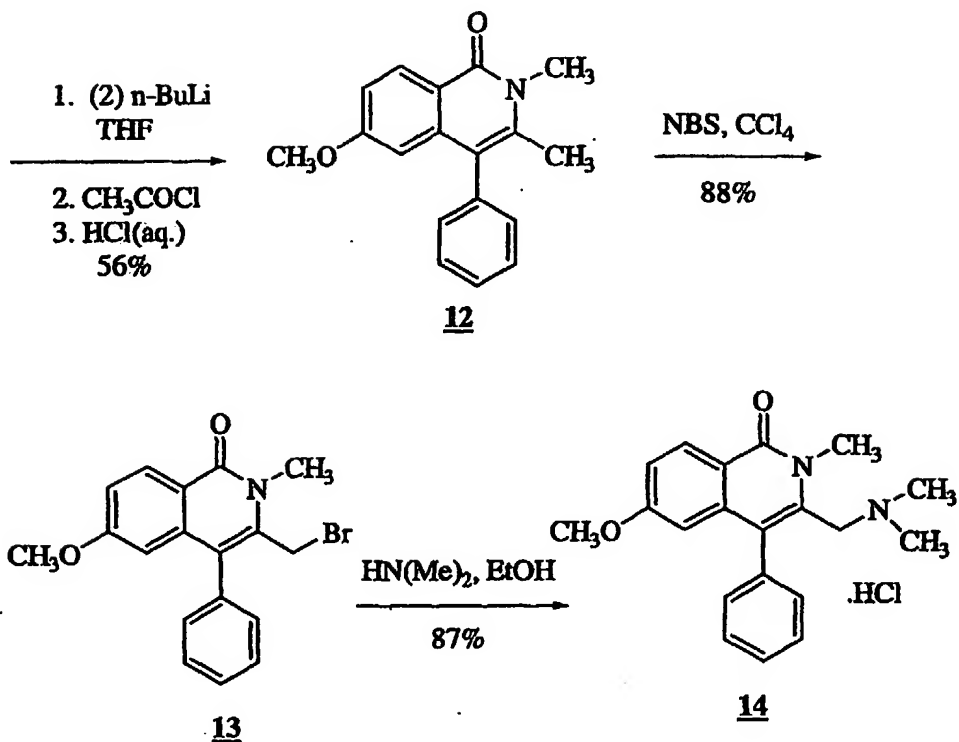
## EXAMPLE 1

Reaction scheme of 3-Dimethylaminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one Hydrochloride (14)

5

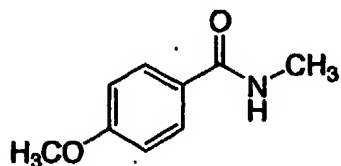


## EXAMPLE 1 (CONTINUED)



5

## EXAMPLE 2

10 4-Methoxy-N-methyl-benzamide (8)

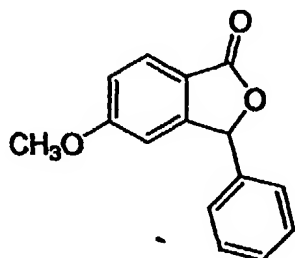
An addition funnel containing p-anisoyl chloride (47.6g, 279mmol) and methylene chloride (125mL) was attached to a 2L 3-neck round bottom flask containing 375mL methylene chloride. The reaction flask was cooled in an ice bath and methylamine (g) was bubbled through the solvent. The contents of the addition funnel were added dropwise. A white precipitate appeared. Warmed to room temperature and stirred for 24h. Washed with water, separated layers and dried the

15

organic portion with sodium sulfate (anh.). Removal of the solvent in vacuo followed by trituration with hexane/ether gave **8** as a white solid (33.7g, 204mmol, 73.2%)  
<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 7.80 (d, 2H); 6.95 (d, 2H); 6.10 (s, br, 1H); 3.85 (s, 3H), 3.00 (d, 3H).

5

## EXAMPLE 3

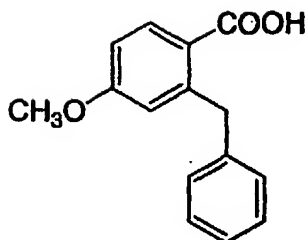
10 5-Methoxy-3-phenyl-3H-isobenzofuran-1-one (9)

A solution of **8** (15g, 91mmol) in THF was cooled to -70 °C under Argon. To this was added sec-butyllithium (147mL, 1.3M). After stirring 0.5h a tan suspension resulted. Added benzaldehyde (9.2mL, 91mmol.) and stirred 1h.

Quenched with ice then removed THF in vacuo. Added sat. sodium bicarbonate and extracted with ethyl acetate (4x). Dried the combined organic portions with sodium sulfate (anh.) and removed the solvent in vacuo. Added toluene and heated to reflux for 18h. Removal of the solvent in vacuo followed by trituration with hexane/ether gave unreacted starting material **8** (4.63g). Concentration of the filtrate in vacuo followed by flash column chromatography (hexane: ethyl acetate 80:20) gave **9** as a yellow solid (12.0g, 50.1mmol, 55.1%)

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 7.90 (d, 1H); 7.40-7.20 (m, 4H); 7.05 (d, 1H); 6.75 (s, 1H), 6.30 (s, 1H); 3.82 (s, 3H).

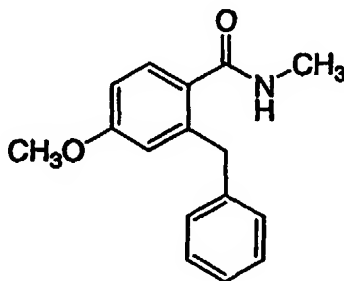
## EXAMPLE 4

5 2-Benzyl-4-methoxy-benzoic acid (10)

To a solution of **9** (12.0g, 50mmol) in ethanol was added 10% palladium on carbon (1.5g). The resulting suspension was hydrogenated at 60psi for 18h. Filtration through celite followed by removal of the solvent in vacuo gave **10** as a white solid (11.0g, 45.5mmol, 91.1%).

10  $^1\text{H}$ NMR ( $\text{CHCl}_3$ , 300MHz)  $\delta$  8.10 (d, 1H); 7.40-7.20 (m, 5H); 6.81 (d, 1H); 6.70 (s, 1H), 4.42 (s, 2H); 3.90 (s, 3H).

## EXAMPLE 5



15

2-Benzyl-4-methoxy-N-methyl-benzamide (11)

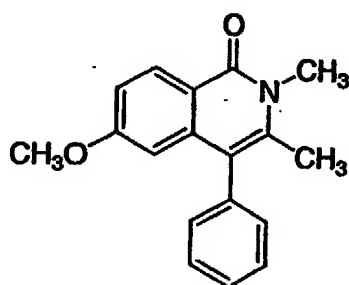
To an ice bath cooled solution of **10** (11.8g, 48.8mmol) in methylene chloride under Argon was added oxalyl chloride (5.10mL, 58.5mmol). Added a few drops of DMF and warmed to room temperature. After 18h the solvent was removed in vacuo. Methylene chloride and methylamine hydrochloride (6.54g, 97.6mmol) were added and the contents of the reaction flask were cooled in an ice bath. Diisopropylethylamine was added dropwise using an addition funnel. After 3h the reaction solution was washed with 5% potassium bisulfate, sat. sodium bicarbonate,



and brine. Dried the organic layer with sodium sulfate (anh.) and removed the solvent in vacuo. Trituration with hexane/ether gave 11 as a light solid (8.15g, 32.0mmol, 65.5%).

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 7.40-7.10 (m, 6H); 6.78 (m, 2H); 5.50 (s, br, 1H); 4.20 (s, 2H), 3.80 (s, 3H); 2.82 (d, 3H).

#### EXAMPLE 6



10

#### 6-Methoxy-2,3-dimethyl-4-phenyl-2H-isoquinolin-1-one (12)

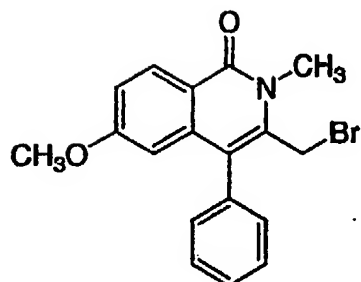
To a solution of 11 (5.00g, 19.6mmol) in THF under Argon at -70°C was added n-butyllithium (18.8mL, 2.5M). After 0.5h acetyl chloride (2.10mL, 29.4mmol) was added. Stirred 0.5h then added water and warmed to room

15 temperature. Removed the solvent in vacuo and added 1N hydrochloric acid. Extracted with ethyl acetate (4x) and dried the combined organic portions with magnesium sulfate (anh.). Removal of the solvent in vacuo followed by trituration with ether gave 12 as a light solid (2.54g, 9.10mmol, 46.4%).

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.40 (d, 1H); 7.55-7.40 (m, 3H); 7.23 (m, 2H); 7.00 (m, 2H), 6.28 (m, 1H); 3.85 (s, 6H); 2.20 (s, 3H).

20

## EXAMPLE 7

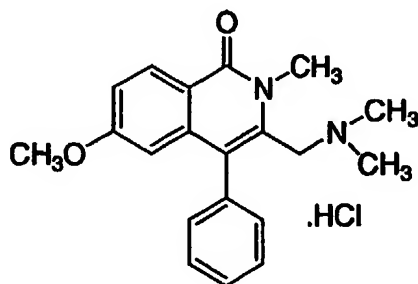
5 3-Bromomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one (13)

To a solution of 12 (3.08g, 11.0mmol) in carbon tetrachloride under Argon was added N-bromosuccinimide (1.96g, 11.0mmol). The contents of the reaction flask were heated to reflux. After 3h an additional portion of N-

10 bromosuccinimide (0.50g, 2.81mmol) was added to the reaction flask. After 7h the solvent was removed in vacuo and sat. sodium bicarbonate was added. Extracted with methylene chloride (4x) and dried the combined organic portions with magnesium sulfate (anh.). Removal of the solvent in vacuo followed by trituration with ether

15 gave 13 as a light solid (3.47g, 9.70mmol, 88.2%)  
<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.41 (d, 1H); 7.60-7.50 (m, 3H); 7.40 (m, 2H); 7.05 (m, 2H), 6.28 (s, 1H); 4.28 (s, 2H); 3.80 (s, 3H); 3.65 (s, 3H).

## EXAMPLE 8



3-Dimethylaminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one Hydrochloride (14)

An ice bath cooled solution of 6 (3.47g, 9.70mmol) in ethanol was saturated with dimethylamine (g). The resulting solution was heated in a Parr pressure reactor at 60°C for 5h. The solvent was removed in vacuo and sat. sodium bicarbonate was added. Extracted with methylene chloride (4x) and dried the combined organic portions with magnesium sulfate (anh.). Removal of the solvent in vacuo followed by flash column chromatography (hexane:ethyl acetate 60:40) gave a white solid after removal of the solvent in vacuo. Dissolved in ethyl acetate and cooled in an ice bath. Addition of 1N hydrogen chloride in ether gave a white solid (14) which was isolated by vacuum filtration (3.00G, 8.40mmol, 86.6%).  
<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 12.60 (s, br, 1H); 8.45 (d, 1H); 7.60 (m, 3H); 7.25 (m, 2H), 7.15 (m, 1H); 6.38 (s, 1H); 4.30 (s, br, 2H); 4.00 (s, 3H); 3.70 (s, 3H); 2.62 (s, 6H).

Compounds 16-38 were prepared using a procedure similar to that described for compound 14. These substances are summarized in Table 1.

EXAMPLE 9

3-(Isobutylamino-methyl)-2-methyl-4-phenyl-2H-isoquinolin-1-one (17)

<sup>1</sup>HNMR (CDCl<sub>3</sub>, 300MHz) δ 8.52-8.46 (m, 1H); 7.52-7.40 (m, 5H); 7.29-7.23 (m, 2H); 6.99-6.96 (m, 1H); 3.87 (s, 3H); 3.45 (s, 2H); 2.26 (d, 2H); 1.58 (m, 1H); 0.82 (d, 6H).

EXAMPLE 10

6-Methoxy-2-methyl-3-(4-methyl-piperidin-1-ylmethyl)-4-phenyl-2H-isoquinolin-1-one (24)

<sup>1</sup>HNMR (CDCl<sub>3</sub>, 300MHz) δ 8.43 (d, 1H); 7.45 (m, 3H); 7.21-7.18 (m, 2H); 7.01 (m, 1H); 6.28 (d, 1H); 3.85 (s, 3H); 3.66 (s, 3H); 2.74 (m, 2H); 1.78-1.70 (m, 2H); 1.50 (m, 2H); 1.21-1.06 (m, 3H); 0.84 (d, 3H).

## EXAMPLE 11

3-(2,3-Dihydro-indol-1-ylmethyl)-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one (26)

5

<sup>1</sup>HNMR (CDCl<sub>3</sub>, 300MHz) δ 8.46 (d, 1H); 7.48-7.36 (m, 3H); 7.24 (m, 2H); 7.08 (m, 3H); 6.69 (m, 1H); 6.52 (m, 1H); 6.36 (d, 1H); 4.09 (s, 2H); 3.78 (s, 3H); 3.69 (s, 3H); 3.08 (t, 2H); 2.84 (t, 2H).

10

## EXAMPLE 12

6-Methoxy-2-methyl-4-phenyl-3-piperidin-1-ylmethyl-2H-isoquinolin-1-one (28)

<sup>1</sup>HNMR (CDCl<sub>3</sub>, 300MHz) δ 8.43 (d, 1H); 7.44 (m, 3H); 7.20 (m, 2H); 7.02 (m, 1H); 6.29 (d, 1H); 3.86 (s, 3H); 3.66 (s, 3H); 3.29 (s, 2H); 2.28 (m, br, 4H); 1.46 (m, 4H); 1.32 (m, 2H).

15

## EXAMPLE 13

3-[(tert-Butyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one (30)

<sup>1</sup>HNMR (CDCl<sub>3</sub>, 300MHz) δ 8.41 (d, 1H); 7.46-7.35 (m, 3H); 7.21-7.28 (m, 2H); 7.01 (dd, 1H); 6.30 (d, 1H); 3.93 (s, 3H); 3.66 (s, 3H); 3.52 (s, 2H); 1.98 (s, 3H); 0.98 (s, 9H).

25

## EXAMPLE 14

3-[(Ethyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one (32)

30

<sup>1</sup>HNMR (CDCl<sub>3</sub>, 300MHz) δ 8.43 (d, 1H); 7.44 (m, 3H); 7.19 (m, 2H); 7.02 (m, 1H); 6.30 (d, 1H); 3.86 (s, 3H); 3.67 (s, 3H); 3.34 (s, 2H); 2.31 (q, 2H); 2.04 (s, 3H); 0.95 (t, 3H).

35

## EXAMPLE 15

6-Methoxy-2-methyl-3-methylaminomethyl-4-phenyl-2H-isoquinolin-1-one (33)

- 5 <sup>1</sup>HNMR (CDCl<sub>3</sub>, 300MHz) δ 8.42 (d, 1H); 7.46 (m, 3H); 7.25 (m, 2H); 7.01 (m, 1H); 6.32 (d, 1H); 3.82 (s, 3H); 3.67 (s, 3H); 3.45 (s, 2H); 2.92 (s, 3H).

## EXAMPLE 16

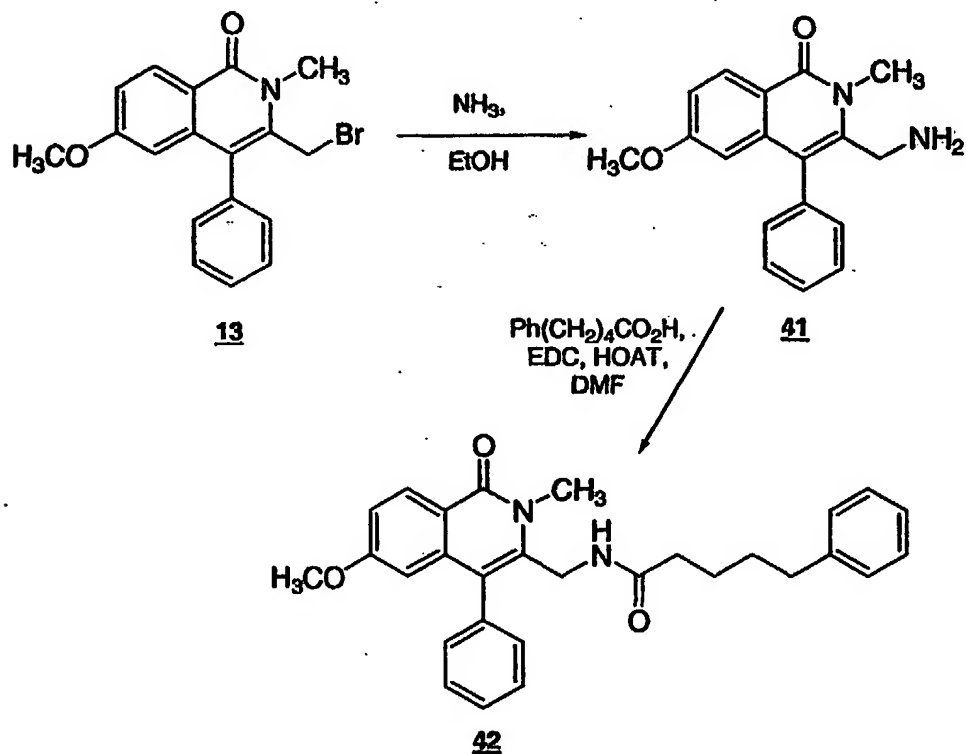
- 10 3-[(Isopropyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one (34)

- <sup>1</sup>HNMR (CDCl<sub>3</sub>, 300MHz) δ 8.42 (d, 1H); 7.45-7.38 (m, 3H); 7.24-7.18 (m, 2H); 7.01 (dd, 1H); 6.32 (d, 1H); 3.84 (s, 3H); 3.67 (s, 3H); 3.41 (s, 2H); 2.80 (m, 1H);  
15 1.98 (s, 3H); 0.80 (d, 6H).

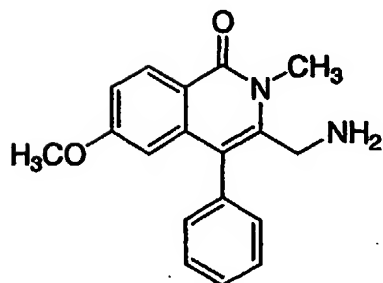
## EXAMPLE 17

Reaction scheme of 5-Phenyl-pentanoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide (42)

5



## EXAMPLE 18



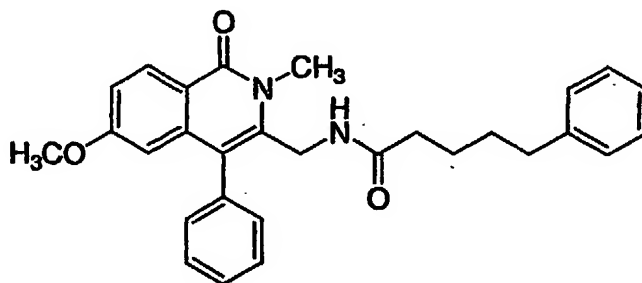
10

3-Aminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one (41)

A solution of 13 (1.50g, 4.19mmol) in ethanol was cooled to 0°C in a threaded pressure tube. Ammonia gas was bubbled through the solution for 10 min. then the vessel was sealed and heated to 60°C for 48h. The contents of the pressure tube were cooled then the solvent was removed in vacuo and sat. sodium bicarbonate was added. Extracted with ethyl acetate (3×) and dried the combined organic portions with sodium sulfate (anh.). Concentration of the filtrate in vacuo followed by flash column chromatography (methylene chloride : methanol : ammonium hydroxide 90:10:1) gave 41 as a white solid (864mg, 2.94mmol, 70.1%).

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.42 (d, 1H); 7.55-7.45 (m, 3H); 7.31-7.25 (m, 2H); 7.05 (dd, 1H), 6.32 (d, 1H); 3.83 (s, 1H); 3.67 (s, 3H); 3.65 (s, 2H); 1.22 (s, br, 2H).

EXAMPLE 19



5-Phenyl-pentanoic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide (42)

A solution of 41 (50mg, 0.170mmol), 5-phenylvaleric acid (33mg, 0.187mmol), 1-[3-(dimethylamino)propyl]-3-ethylcarbodiimide hydrochloride (36mg, 0.187mmol), 1-hydroxy-7-azabenzotriazole (25mg, 0.187mmol) in N,N-dimethylformamide was stirred at room temperature for 18h. The contents of the reaction flask were poured into water and sat. sodium bicarbonate. Extracted with methylene chloride (3×). The combined organic extracts were washed with 5% potassium bisulfate, dried with sodium sulfate (anh.) and filtered. Concentration of the filtrate in vacuo followed by trituration with ether gave 42 as a white solid (62mg, 140mmol, 82.1%).

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.34 (d, 1H); 7.46-7.43 (m, 3H); 7.29-7.14 (m, 7H); 6.98-6.95 (m, 1H), 6.24 (d, 1H); 5.73 (s, 1H); 4.27 (d, 2H); 3.65 (s, 3H); 3.61 (s, 3H); 2.63 (m, 2H); 2.24 (m, 2H); 1.66 (m, 4H).

- 5 Compounds 43-97 were prepared using a procedure similar to that described for compound 42. These substances are summarized in Table 2.

#### EXAMPLE 20

- 10 Biphenyl-3-carboxylic acid (6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-amide (96)

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.32 (d, 1H); 8.11 (s, 1H); 7.86-7.76 (m, 2H); 7.63 (m, 2H); 7.56-7.32 (m, 9H); 6.93 (m, 1H); 6.84 (s, br, 1H); 6.25 (d, 1H); 4.51 (d, 2H);  
15 3.67 (s, 3H); 3.64 (s, 3H).

#### EXAMPLE 21

- 20 2-(5-Methoxy-2-methyl-1H-indol-3-yl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-acetamide (97)

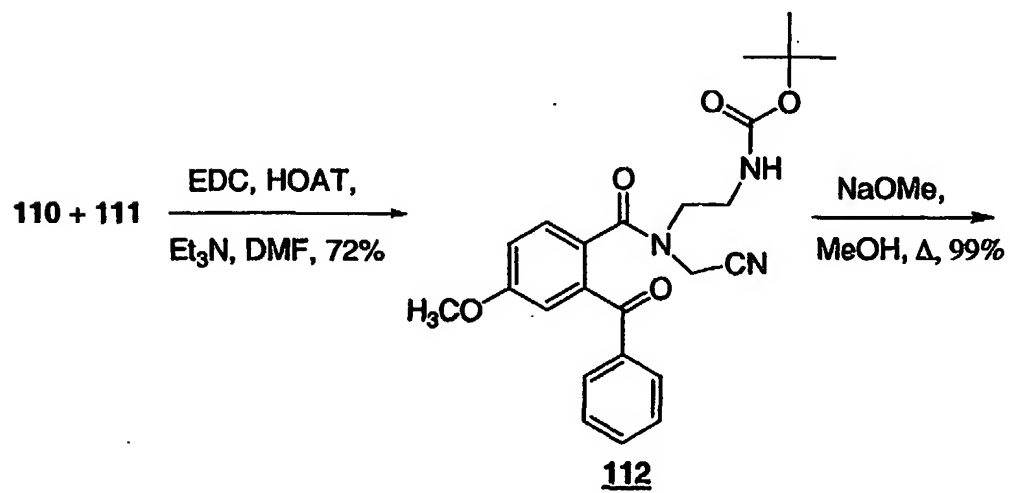
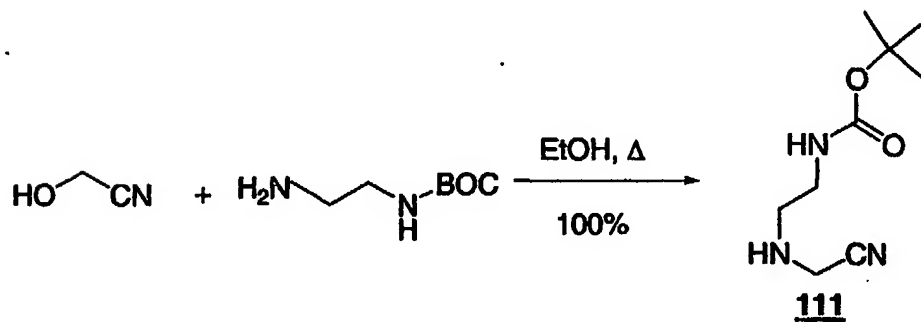
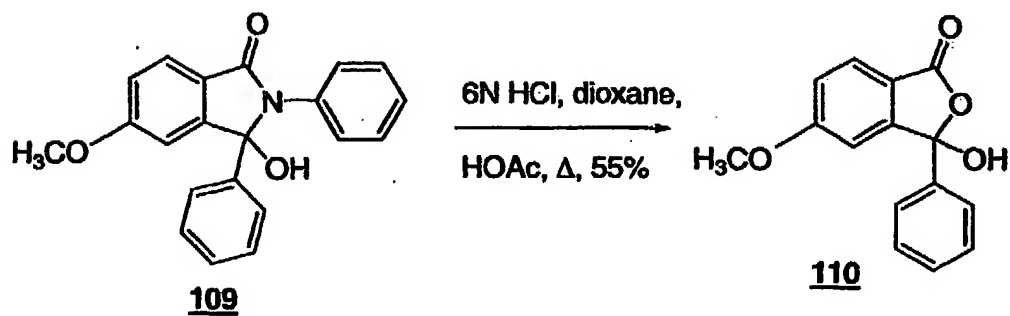
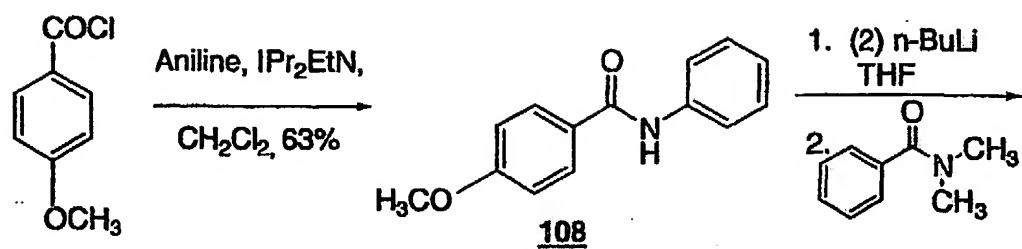
<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.36 (d, 1H); 7.90 (s, 1H); 7.35-7.18 (m, 3H); 7.00 (m, 1H); 6.84 (m, 1H); 6.72 (m, 3H); 6.19 (m, 1H); 5.61 (m, 1H); 4.20 (d, 2H); 3.75 (s, 3H); 3.60 (m, 8H); 2.33 (s, 3H).

- 25 

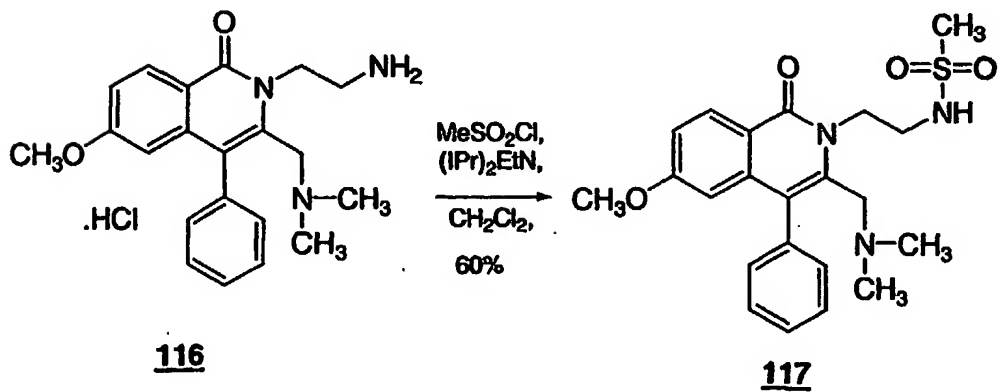
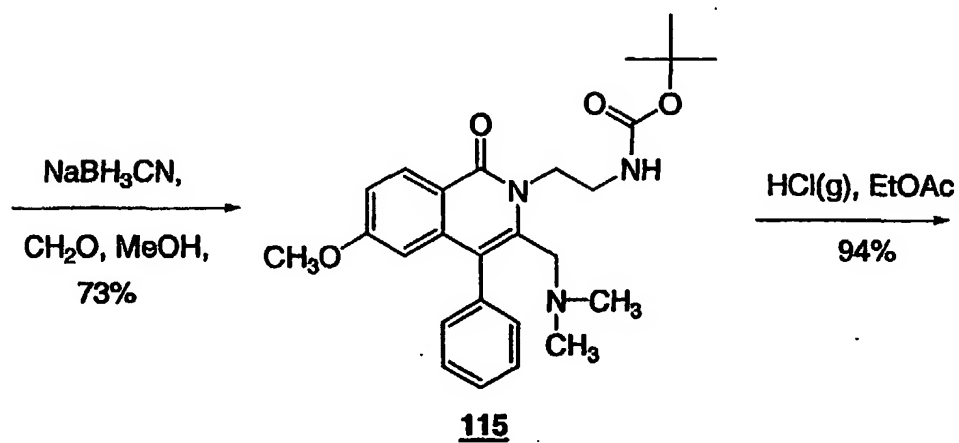
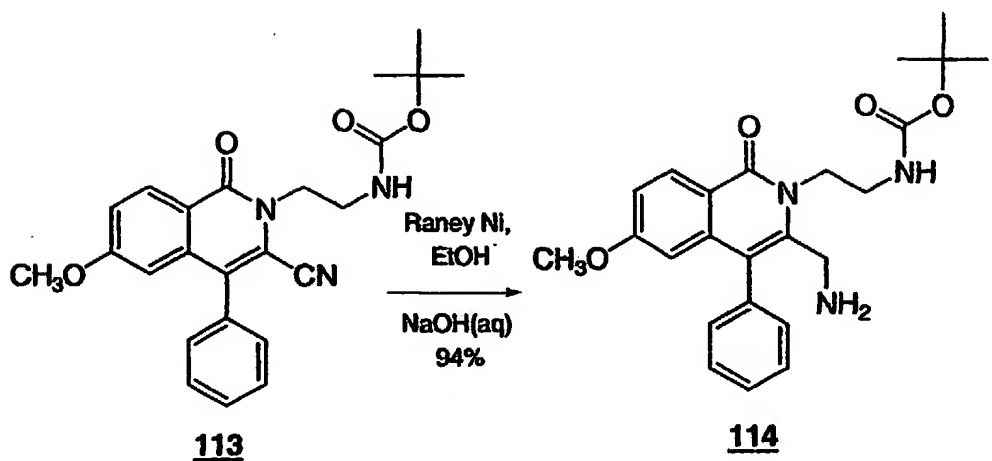
#### EXAMPLE 22

Reaction scheme of N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-methanesulfonamide (117)

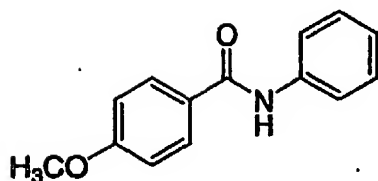




## EXAMPLE 22 (CONTINUED)



## EXAMPLE 23



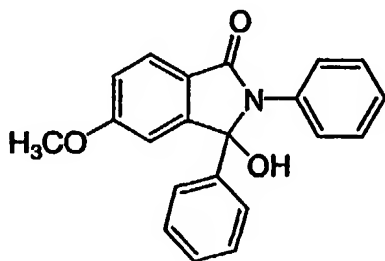
5

4-Methoxy-N-phenylbenzamide (108)

p-Anisoyl chloride (10g, 58.5mmol) and methylene chloride (500mL) were combined under Ar. Aniline (8.0mL, 87.7mmol) was added dropwise with stirring. Diisopropylethylamine (10.0mL, 58.5mmol) was added dropwise to give a white suspension. After 3h the contents of the reaction flask were washed with 5% potassium bisulfate then sat. sodium bicarbonate. The organic portion was dried with sodium sulfate (anh.), filtered and evaporated in vacuo to give a solid. Trituration with ethyl acetate gave 108 as a white solid (3.37g, 14.8mmol, 25.4%).

15 <sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 7.88-7.82 (m, 2H); 7.74 (s, br, 1H); 7.66-7.60 (m, 2H); 7.42-7.34 (m, 2H), 7.18-7.10 (m, 1H); 7.02-6.94 (m, 2H); 3.88 (s, 3H).

## EXAMPLE 24



20

3-Hydroxy-5-methoxy-2,3-diphenyl-2,3-dihydro-isoindol-1-one (109)

Combined under Ar 108 (3.00g, 13.2mmol) and tetrahydrofuran. Cooled in an IPA/dry ice bath. Added dropwise n-butyllithium solution (2.5M in hexanes, 11.1mL, 27.8mmol). Stirred 0.5h with cooling then warmed over 0.5h to -15°C. Recooled using IPA/dry ice and added a tetrahydrofuran solution of N,N-dimethylbenzamide

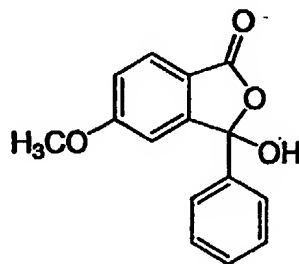
25

(2.38g, 15.8mmol). Warmed to room temperature and quenched with water. Removed solvent in vacuo; added sat. sodium bicarbonate and extracted with ethyl acetate (3×). Dried combined organic portions with sodium sulfate (anh.), filtered, removed solvent in vacuo. A solid resulted which was triturated with ether to give  
5 109 as a white solid (3.11g, 9.39mmol, 71.2%).

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 7.60 (d, 1H); 7.48-7.35 (m, 4H); 7.28-7.05 (m, 6H); 6.85 (m, 1H), 6.75 (m, 1H); 4.00 (s, 1H); 3.79 (s, 3H).

10

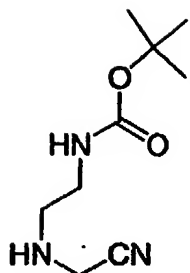
## EXAMPLE 25

3-Hydroxy-5-methoxy-3-phenyl-3H-isobenzofuran-1-one (110)

15

A solution of 109 (3.11g, 9.39mmol), 6N hydrochloric acid (150mL), and dioxane (150mL) was heated at reflux under Ar for 18h. Acetic acid (50mL) was added and refluxing was continued for an additional 4h. The organic solvents were removed in vacuo and the remaining aqueous was extracted with ethyl acetate (3×), washed with brine and dried with sodium sulfate (anh.). Filtration followed by  
20 removal of the solvent in vacuo gave 110 as a white solid (1.32g, 5.16mmol, 54.9%)  
<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.05 (d, 1H); 7.74 (d, 2H); 7.55 (m, 1H); 7.41 (m, 2H), 7.02 (m, 1H); 6.83 (m, 1H); 3.86 (s, 3H).

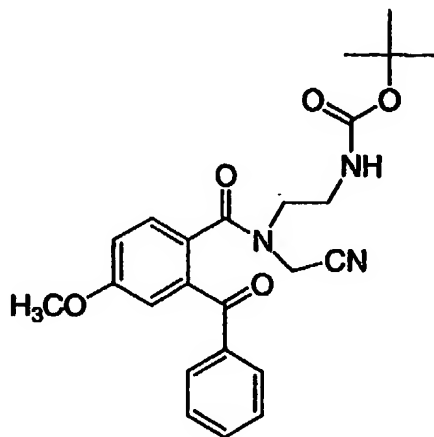
## EXAMPLE 26

5 [2-(Cyanomethyl-amino)-ethyl]-carbamic acid tert-butyl ester (111)

Glycolonitrile (70%, 5.10g, 62.5mmol), tert-butyl-N-(2-aminoethyl)carbamate (10.0g, 62.5mmol), and ethanol (200mL) were combined under Ar and heated at reflux for 4h. Removal of the solvent in vacuo gave 111 as a yellow oil.

- 10 <sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 4.83 (s, br, 1H); 3.62 (s, 2H); 3.28 (m, 2H); 2.85 (m, 2H), 1.90 (s, br, 1H); 1.45 (s, 9H).

## EXAMPLE 27



15

[2-(Cyanomethyl)-{1-[4-methoxy-2-(1-phenyl-methanoyl)-phenyl]-methanoyl}-amino)-ethyl]-carbamic acid tert-butyl ester (112)

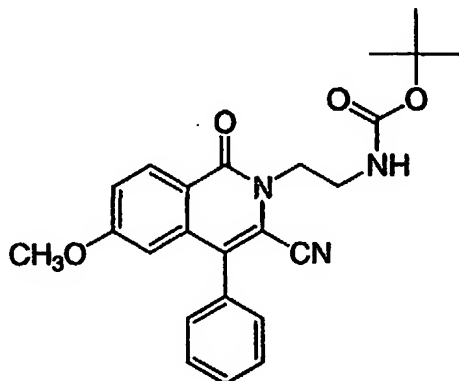
- 20 A solution of 110 (2.55g, 9.96mmol), 111 (2.38g, 12.0mmol), 1-[3-(dimethylamino)propyl]-3-ethylcarbodiimide hydrochloride (2.30g, 12.0mmol), 1-

hydroxy-7-azabenzotriazole (1.63g, 12.0mmol) in N,N-dimethylformamide was stirred at room temperature for 4 days. The contents of the reaction flask were poured into water and sat. sodium bicarbonate. Extracted with methylene chloride (3×). The combined organic extracts were dried with sodium sulfate (anh.) and filtered.

- 5 Concentration of the filtrate in vacuo followed flash column chromatography (hexane : ethyl acetate 60:40) gave 112 as a white foam (3.16g, 7.23mmol, 72.6%).

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 7.85 (d, 2H); 7.61 (m, 1H); 7.52-7.35 (m, 3H); 7.15-7.05 (m, 2H), 5.50 (s, br, 1H); 4.35 (m, 2H); 3.85 (s, 3H); 3.65 (m, 2H); 3.35 (m, 2H); 1.40 (s, 9H).

#### EXAMPLE 28



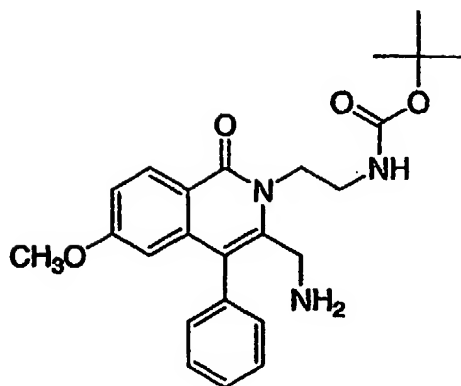
15

[2-(3-Cyano-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-carbamic acid tert-butyl ester (113)

- A solution of 112 (3.16g, 7.23mmol), sodium methoxide (0.5M, 31.8mL, 15.9mmol) and methanol (100mL) was heated at reflux for 1h. The solvent was removed in vacuo and sat. sodium bicarbonate was added. Extracted with methylene chloride (3×). The combined organic extracts were dried with magnesium sulfate (anh.) and filtered. The filtrate was removed in vacuo to give 113 as a white solid (3.04g, 7.23mmol, 100%).

- 25 <sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.46 (d, 1H); 7.60-7.50 (m, 3H); 7.50-7.40 (m, 2H); 7.22 (dd, 1H), 6.66 (d, 1H); 5.00 (s, br, 1H); 4.45 (m, 2H); 3.75 (s, 3H); 3.65 (m, 2H); 1.30 (s, 9H).

## EXAMPLE 29



5

[2-(3-Aminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-carbamic acid tert-butyl ester (114)

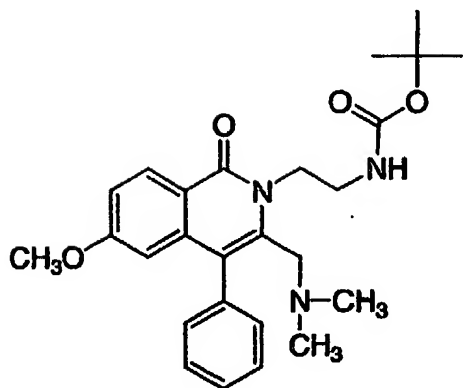
A suspension of 113 (3.04g, 7.26mmol), raney nickel, ammonium hydroxide (10mL), and ethanol (50mL) were combined in a Parr jar and hydrogenated at 55 psi for 18h. The contents of the Parr jar were filtered through Celite and the filtrate was rotary evaporated to give 114 as a white solid (2.72g, 6.43mmol, 88.6%).

10

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.40 (d, 1H); 7.50 (m, 3H); 7.29 (m, 2H); 7.05 (m, 1H), 6.31 (s, 1H); 5.45 (s, br, 1H); 4.50 (m, 2H); 3.85-3.50 (m, 7H); 1.28 (s, 9H).

15

## EXAMPLE 30



5 [2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-  
carbamic acid tert-butyl ester (115)

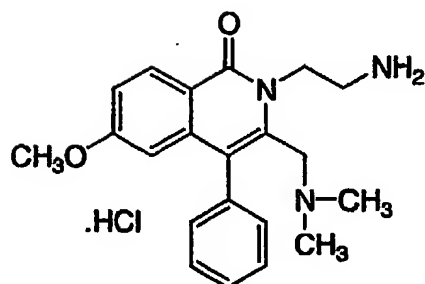
A solution of 114 (2.72g, 6.43mmol), formaldehyde (12.3M, 2.62mL, 32.2mmol), sodium cyanoborohydride (1.0M in tetrahydrofuran, 32.2mL, 32.2mmol), and methanol (100mL) were heated at reflux for 1h. The contents of the reaction flask  
 10 were cooled and the solvent was removed in vacuo. Sat. sodium bicarbonate was added and the resulting mixture was extracted with ethyl acetate(3×). The combined organic extracts were dried with magnesium sulfate (anh.) and filtered. The filtrate was removed by rotary evaporation to give a colorless oil. Trituration with hexane : ether (1:1) gave 115 as a white solid (2.21g, 4.90mmol, 76.2%).

15

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.40 (d, 1H); 7.48 (m, 3H); 7.22 (m, 2H); 7.05 (dd, 1H), 6.30 (d, 1H); 5.70 (m, 1H); 4.55 (m, 2H); 3.66 (s, 3H); 3.52 (m, 2H); 3.35 (m, 2H); 2.13 (s, 6H); 1.40 (s, 9H).



## EXAMPLE 31



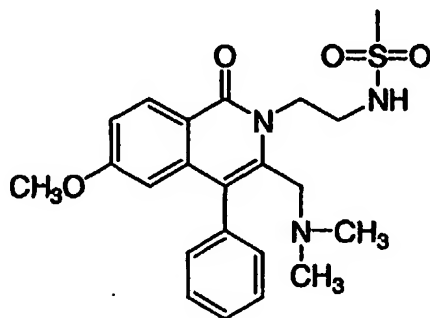
5 2-(2-Amino-ethyl)-3-dimethylaminomethyl-6-methoxy-4-phenyl-2H-isoquinolin-1-  
one (116)

A solution of 115 (1.71g, 3.79mmol) in ethyl acetate (200mL) was cooled in an ice bath with stirring. Hydrogen chloride gas was bubbled through the solution for 15min. then the contents of the reaction flask were warmed to room  
10 temperature. After 1.25h the solvent was removed in vacuo and the remaining residue was triturated with ether to give 116 as a white solid (1.37g, 3.54mmol, 93.6%).

<sup>1</sup>HNMR (CH<sub>3</sub>OH, 300MHz) δ 8.40 (d, 1H); 7.68-7.58 (m, 3H); 7.50-7.42 (m, 2H);  
7.28 (dd, 1H), 4.60-4.46 (m, 4H); 3.50 (s, 3H); 3.36 (m, 2H); 2.80 (s, 6H).

15

## EXAMPLE 32



N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-methanesulfonamide (117)

A solution of 116 (50mg, 0.118mmol), triethylamine (66μL, 0.472mmol), methanesulfonyl chloride (12μL, 0.153mmol) and methylene chloride (250μL) were combined under Ar and stirred at room temperature 24h. Added methylene chloride and washed the contents of the reaction flask with sat. sodium bicarbonate. Dried the organic layer with sodium sulfate (anh.), filtered then rotary evaporated the filtrate. Trituration of the resulting solid with ether gave 117 as a white solid (35mg, 0.082mmol, 69.1%).

10

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.40 (m, 2H); 7.54-7.44 (m, 3H); 7.20 (m, 2H); 7.06 (dd, 1H); 4.36 (m, 2H); 3.67 (m, 5H); 3.39 (s, 2H); 2.79 (s, 3H); 2.17 (s, 6H).

15

Compounds 118-132 were prepared using a procedure similar to that described for compound 117. These substances are summarized in Table 3.

EXAMPLE 33

20

Butane-1-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide (119)

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.40 (d, 1H); 8.23 (s, 1H); 7.48 (m, 3H); 7.20 (m, 2H); 7.05 (m, 1H); 6.30 (d, 1H); 4.37 (m, 2H); 3.68 (m, 5H); 3.40 (s, 2H); 2.88 (t, 2H); 2.18 (s, 6H); 1.59 (m, 2H); 1.25 (m, 2H); 0.73 (t, 3H).

25

EXAMPLE 34

30

Thiophene-2-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide (122)

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 9.50 (s, 1H); 8.37 (d, 1H); 7.50 (m, 4H); 7.20 (m, 2H); 7.12-7.03 (m, 2H); 6.77 (m, 1H); 6.25 (d, 1H); 4.34 (m, 2H); 3.69 (s, 3H); 3.60 (m, 2H); 3.37 (s, 2H); 2.23 (s, 6H).

## EXAMPLE 35

N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-4-methoxy-benzenesulfonamide (124)

5

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.51 (s, 1H); 8.26 (d, 1H); 7.62 (m, 2H); 7.48 (m, 4H); 7.15 (m, 2H); 7.04 (m, 1H); 6.64 (m, 2H); 6.24 (d, 1H); 4.27 (m, 2H); 3.68 (s, 3H); 3.67 (s, 3H); 3.53 (m, 1H); 3.32 (s, 1H); 2.18 (s, 6H).

10

## EXAMPLE 36

N-[2-(3-Dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-4-methyl-benzenesulfonamide (125)

15

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 8.60 (m, 1H); 8.26 (d, 1H); 7.58 (m, 2H); 7.46 (m, 3H); 7.15 (m, 2H); 7.04 (m, 1H); 6.96 (d, 2H); 6.24 (d, 1H); 4.45 (m, 2H); 3.69 (s, 3H); 3.54 (m, 2H); 3.62 (d, 2H); 2.19 (s, 9H).

## EXAMPLE 37

20

1-Methyl-1H-imidazole-4-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide (127)

25

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 9.37 (s, 1H); 8.24 (d, 1H); 7.48 (m, 3H); 7.29 (m, 3H); 7.02 (m, 1H); 6.54 (s, 1H); 6.28 (m, 1H); 4.20 (m, 2H); 3.69 (s, 3H); 3.57 (m, 2H); 3.45 (s, 3H); 3.37 (s, 2H); 2.32 (s, 6H).

## EXAMPLE 38

30

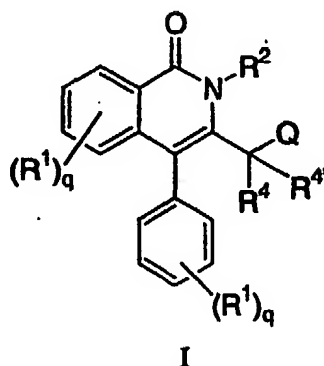
3,5-Dimethyl-isoxazole-4-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide (129)

35

<sup>1</sup>HNMR (CHCl<sub>3</sub>, 300MHz) δ 9.31 (m, 1H); 8.35 (d, 1H); 7.49 (m, 3H); 7.20 (m, 2H); 7.08 (m, 1H); 6.30 (d, 1H); 4.31 (m, 2H); 3.69 (s, 3H); 3.49 (m, 2H); 3.40 (s, 2H); 2.59 (s, 3H); 2.27 (s, 3H); 2.40 (s, 6H).

## WHAT IS CLAIMED IS:

- 5                    1.      A compound of structural Formula I:



- 10      or a pharmaceutically acceptable salts, hydrates, solvates, crystal forms, or stereoisomers thereof, wherein:

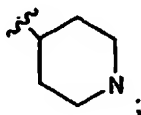
$R^1$  is:

- 15                    (1)      hydrogen,  
                       (2)      (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
                       (5)      (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
                       (6)      (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or  
                       (5)      halo, wherein halo is fluoro, chloro, bromo, or iodo;

$R^2$  is:

- 20                    (1)      (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
                       (2)      (CH<sub>2</sub>)<sub>n</sub>-(T)[S(O)<sub>m</sub>]<sub>p</sub>R<sup>3</sup>, or  
                       (3)      (CH<sub>2</sub>)<sub>n</sub>-(T)COR<sup>3</sup>;

wherein T is -NH or



25

n is:    1, 2, or 3;

m is: 0, 1, or 2;

p is: 0 or 1;

q is: 1, 2, 3, or 4;

5  $R^3$  is:

(1) aryl, wherein aryl is defined as phenyl or naphthyl which is optionally substituted with one, two or three of the substituents selected from the group consisting of:

- 10 (a) halo, wherein halo is fluoro, chloro, bromo, or iodo,  
(b)  $(C_1-C_6)$ -alkyl,  
(c)  $(C_1-C_6)$ -alkoxy,  
(d)  $(C_1-C_4)$ -perfluoroalkyl,  
(e)  $(C_1-C_4)$ -perfluoroalkoxy,  
(f) phenyl, and  
15 (g) benzyl;

(2) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

- 20 (a) halo, as defined above,  
(b)  $(C_1-C_6)$ -alkyl,  
(c)  $(C_1-C_4)$ -perfluoroalkyl, and  
(d)  $(C_1-C_6)$ -alkoxy;  
(3)  $(C_1-C_6)$ -alkyl optionally substituted with phenyl; or  
25 (4)  $(C_1-C_6)$ -alkoxy;

$R^4$  and  $R^{4'}$  are independently:

- (1) H,  
(2)  $(C_1-C_4)$ -alkyl,  
30 (3)  $(C_3-C_7)$ -cycloalkyl,  
(4) halo,  
(5)  $(C_1-C_4)$ -perfluoroalkyl, or  
(6)  $R^4$  and  $R^{4'}$  are taken together form a  $(C_3-C_7)$ -cycloalkyl ring;

35 Q is:

- (1)  $\text{NR}^5\text{R}^6$ , wherein  $\text{R}^5$  and  $\text{R}^6$  are independently:
- (a) H,
  - (b)  $(\text{C}_1\text{-C}_4)\text{-perfluoroalkyl}$ ,
  - (c)  $(\text{C}_3\text{-C}_7)\text{-cycloalkyl}$ ,
  - (d)  $(\text{C}_2\text{-C}_6)\text{-alkyl-aryl}$ , wherein aryl is defined as phenyl or naphthyl which is substituted with one, two or three of the substituents selected from the group consisting of halo, hydroxy,  $(\text{C}_1\text{-C}_6)\text{-alkyl}$ ,  $(\text{C}_1\text{-C}_4)\text{-perfluoroalkyl}$ ,  $(\text{C}_1\text{-C}_6)\text{-alkoxy}$ , phenyl, phenoxy, and nitro,
  - (e)  $(\text{C}_1\text{-C}_{10})\text{-alkyl}$ , which is optionally substituted with one, two, or three of the substituents selected from the group consisting of:
    - (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
    - (b') hydroxy,
    - (c') oxo,
    - (d')  $(\text{C}_1\text{-C}_6)\text{-alkoxy}$ ,
    - (e') phenyl, and
    - (f')  $(\text{C}_3\text{-C}_7)\text{-cycloalkyl}$ ; or
  - (f) optionally,  $\text{R}^5$  or  $\text{R}^6$  can be joined with the  $\text{R}^2$  substituent in Formula I to form a 5 to 8 atom heterocyclic ring, and the other of  $\text{R}^5$  or  $\text{R}^6$  is as defined above;
- (2) heterocyclyl, wherein heterocyclyl is defined as a monocyclic or bicyclic ring of 5 to 10 carbon atoms which can be aromatic or nonaromatic, wherein the heterocyclyl is attached to the methylene bearing the  $\text{R}^4$  and  $\text{R}^4$  substituents through a N from the heterocyclyl and may optionally contain 1 to 3 additional heteroatoms selected from N, O or S and is optionally substituted with one, two, or three substituents selected from the group consisting of:
- (a) H,
  - (b)  $(\text{C}_1\text{-C}_6)\text{-alkyl}$ ,
  - (c)  $(\text{C}_1\text{-C}_4)\text{-perfluoroalkyl}$ ,
  - (d)  $(\text{C}_1\text{-C}_4)\text{-alkyl-aryl}$ ,
  - (e)  $\text{CO}_2(\text{C}_1\text{-C}_6)\text{-alkyl}$ ,
  - (f)  $\text{CO}_2\text{H}$
  - (g) oxo, and
  - (h) hydroxy; or
- (3)  $\text{NH}(\text{C}=\text{O})\text{R}^7$ , wherein  $\text{R}^7$  is:

(a) (C<sub>1</sub>-C<sub>13</sub>)-alkyl or (C<sub>1</sub>-C<sub>12</sub>)-alkenyl, which is optionally substituted with one, two, or three substituents selected from the group consisting of:

- 5 (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
- (b') hydroxy,
- (c') oxo,
- (d') nitro,
- (e') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- (f') NR<sup>5</sup>R<sup>6</sup>,
- 10 (g') NH(CO)O(C<sub>1</sub>-C<sub>6</sub>)-alkyl, wherein (C<sub>1</sub>-C<sub>6</sub>)-alkyl is optionally substituted with phenyl,
- (h') CO(C<sub>1</sub>-C<sub>10</sub>)-alkyl,
- (i') OC(O)(C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (j') CONR<sup>5</sup>R<sup>6</sup>,
- 15 (k') O-aryl, wherein aryl as defined in (o') below,
- (l') S-aryl, wherein aryl as defined in (o') below,
- (m') (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, which is optionally substituted with 1 to 3 substituents selected from the group consisting of (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, CO(C<sub>1</sub>-C<sub>6</sub>)-alkyl, oxo and (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with NO<sub>2</sub>,
- 20 (n') (C<sub>5</sub>-C<sub>7</sub>)-cycloalkyl fused with phenyl, wherein (C<sub>5</sub>-C<sub>7</sub>)-cycloalkyl fused with phenyl is optionally substituted with 1 to 3 substituents selected from the group consisting of (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, oxo, and (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- 25 (o') aryl, wherein aryl is defined as phenyl or naphthyl, which is optionally substituted with one, two or three of the substituents selected from the group consisting of:
  - (a'') halo, as defined above,
  - (b'') hydroxy,
  - 30 (c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
  - (d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
  - (e'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, optionally substituted with phenyl,
  - (f'') phenyl,

- (g'') phenoxy, and  
 (h'') nitro;
- (p') heterocyclyl, wherein heterocyclyl is defined as a  
 monocyclic, bicyclic, or tricyclic ring of 5 to 14 carbon atoms  
 5 which can be aromatic or nonaromatic and containing from 1 to  
 3 heteroatoms selected from O, N or S, and the heterocyclyl  
 being optionally substituted or with one, two, or three  
 substituents selected from the group consisting of:
- (a'') H,  
 10 (b'') halo, as defined above,  
 (c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
 (d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
 (e'') (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,  
 (f'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
 15 (g'') phenyl,  
 (h'') phenoxy,  
 (i'') nitro,  
 (j'') CO<sub>2</sub> (C<sub>1</sub>-C<sub>6</sub>)-alkyl, and  
 (k'') oxo; and
- (q') S- heterocyclyl, wherein heterocyclyl as defined under  
 20 (p') above;
- (b) aryl, wherein aryl is defined as phenyl or naphthyl which is  
 optionally substituted with one, two or three of the substituents  
 selected from the group consisting of:
- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,  
 25 (b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
 (c') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
 (d') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl;  
 (e') phenoxy,  
 30 (f') benzyl, and  
 (g') phenyl optionally substituted with (C<sub>1</sub>-C<sub>4</sub>)-  
 perfluoroalkyl;
- (c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, optionally substituted with phenyl; or  
 (d) heteroaryl, wherein heteroaryl is defined as a monocyclic or  
 35 bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3

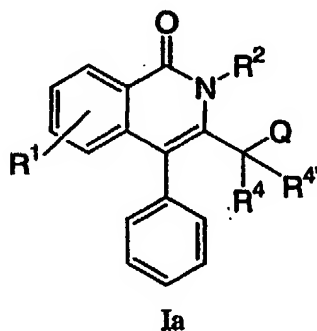


heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

- 5 (a') halo, as defined above,  
 (b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
 (c') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and  
 (d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy.

2. A compound of structural Formula Ia:

10



or a pharmaceutically acceptable salts, hydrates, solvates, crystal forms, or stereoisomers thereof, wherein:

15

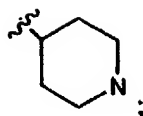
R<sup>1</sup> is:

- (1) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
 (2) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
 20 (3) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or  
 (4) halo, wherein halo is fluoro, chloro, bromo, or iodo;

R<sup>2</sup> is:

- (1) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
 25 (2) (CH<sub>2</sub>)<sub>n</sub>-(T)[S(O)<sub>m</sub>]<sub>p</sub>R<sup>3</sup>, or  
 (3) (CH<sub>2</sub>)<sub>n</sub>-(T)COR<sup>3</sup>;

wherein T is -NH or



n is: 1, 2, or 3;

m is: 0, 1, or 2;

5 p is: 0 or 1;

R<sup>3</sup> is:

10 (1) aryl, wherein aryl is defined as phenyl or naphthyl which is optionally substituted with one, two or three of the substituents selected from the group consisting of:

- (a) halo, wherein halo is fluoro, chloro, bromo, or iodo,
- (b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (c) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- (d) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- 15 (e) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy,
- (f) phenyl, and
- (g) benzyl;

20 (2) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

- (a) halo, as defined above,
- (b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (c) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and
- 25 (d) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy;
- (3) (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with phenyl; or
- (4) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy;

R<sup>4</sup> and R<sup>4'</sup> are independently:

- 30 (1) H,
- (2) (C<sub>1</sub>-C<sub>4</sub>)-alkyl,
- (3) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl,
- (4) halo,

- (5) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, or  
 (6) R<sup>4</sup> and R<sup>4'</sup> are taken together form a (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl ring;

Q is:

- 5 (1) NR<sup>5</sup>R<sup>6</sup>, wherein R<sup>5</sup> and R<sup>6</sup> are independently:
- (a) H,
  - (b) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
  - (c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl,
  - (d) (C<sub>2</sub>-C<sub>6</sub>)-alkyl-aryl, wherein aryl is defined as phenyl or
  - 10 naphthyl which is substituted with one, two or three of the substituents selected from the group consisting of halo, hydroxy, (C<sub>1</sub>-C<sub>6</sub>)-alkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, phenyl, phenoxy, and nitro,
  - (e) (C<sub>1</sub>-C<sub>10</sub>)-alkyl, which is optionally substituted with one, two, or three of the substituents selected from the group consisting of:
  - 15 (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
  - (b') hydroxy,
  - (c') oxo,
  - (d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
  - (e') phenyl, and
  - 20 (f') (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl; or
  - (f) optionally, R<sup>5</sup> or R<sup>6</sup> can be joined with the R<sup>2</sup> substituent in Formula Ia to form a 5 to 8 atom heterocyclic ring, and the other of R<sup>5</sup> or R<sup>6</sup> is as defined above;
  - (2) heterocyclyl, wherein heterocyclyl is defined as a monocyclic or
  - 25 bicyclic ring of 5 to 10 carbon atoms which can be aromatic or nonaromatic, wherein the heterocyclyl is attached to the methylene bearing the R<sup>4</sup> and R<sup>4'</sup> substituents through a N from the heterocyclyl and may optionally contain 1 to 3 additional heteroatoms selected from N, O or S and is optionally substituted with one, two, or three substituents selected from the group consisting of:
  - 30 (a) H,
  - (b) (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
  - (c) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
  - (d) (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,
  - (e) CO<sub>2</sub> (C<sub>1</sub>-C<sub>6</sub>)-alkyl,

- (f)  $\text{CO}_2\text{H}$
- (g) oxo, and
- (h) hydroxy; or
- (3)  $\text{NH}(\text{C}=\text{O})\text{R}^7$ , wherein  $\text{R}^7$  is:
- 5 (a)  $(\text{C}_1\text{-C}_{13})$ -alkyl or  $(\text{C}_1\text{-C}_{12})$ -alkenyl, which is optionally substituted with one, two, or three substituents selected from the group consisting of:
- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
- (b') hydroxy,
- 10 (c') oxo,
- (d') nitro,
- (e')  $(\text{C}_1\text{-C}_6)$ -alkoxy,
- (f')  $\text{NR}^5\text{R}^6$ ,
- (g')  $\text{NH}(\text{CO})\text{O}(\text{C}_1\text{-C}_6)$ -alkyl, wherein  $(\text{C}_1\text{-C}_6)$ -alkyl is
- 15 optionally substituted with phenyl,
- (h')  $\text{CO}(\text{C}_1\text{-C}_{10})$ -alkyl,
- (i')  $\text{OC}(\text{O})(\text{C}_1\text{-C}_6)$ -alkyl,
- (j')  $\text{CONR}^5\text{R}^6$ ,
- (k') O-aryl, wherein aryl as defined in (o') below,
- 20 (l') S-aryl, wherein aryl as defined in (o') below,
- (m')  $(\text{C}_3\text{-C}_7)$ -cycloalkyl, which is optionally substituted with 1 to 3 substituents selected from the group consisting of  $(\text{C}_1\text{-C}_6)$ -alkoxy,  $\text{CO}(\text{C}_1\text{-C}_6)$ -alkyl, oxo and  $(\text{C}_1\text{-C}_6)$ -alkyl optionally substituted with  $\text{NO}_2$ ,
- 25 (n')  $(\text{C}_5\text{-C}_7)$ -cycloalkyl fused with phenyl, wherein  $(\text{C}_5\text{-C}_7)$ -cycloalkyl fused with phenyl is optionally substituted with 1 to 3 substituents selected from the group consisting of  $(\text{C}_1\text{-C}_6)$ -alkoxy, oxo, and  $(\text{C}_1\text{-C}_6)$ -alkyl,
- (o') aryl, wherein aryl is defined as phenyl or naphthyl,
- 30 which is optionally substituted with one, two or three of the substituents selected from the group consisting of:
- (a'') halo, as defined above,
- (b'') hydroxy,
- (c'')  $(\text{C}_1\text{-C}_6)$ -alkyl,

- (d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
(e'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, optionally substituted with  
phenyl,  
(f'') phenyl,  
5 (g'') phenoxy, and  
(h'') nitro;  
(p') heterocyclyl, wherein heterocyclyl is defined as a  
monocyclic, bicyclic, or tricyclic ring of 5 to 14 carbon atoms  
which can be aromatic or nonaromatic and containing from 1 to  
10 3 heteroatoms selected from O, N or S, and the heterocyclyl  
being optionally substituted or with one, two, or three  
substituents selected from the group consisting of:  
(a'') H,  
(b'') halo, as defined above,  
15 (c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
(d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,  
(e'') (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,  
(f'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
(g'') phenyl,  
20 (h'') phenoxy,  
(i'') nitro,  
(j'') CO<sub>2</sub>(C<sub>1</sub>-C<sub>6</sub>)-alkyl, and  
(k'') oxo; and  
(q') S- heterocyclyl, wherein heterocyclyl as defined under  
25 (p') above;  
(b) aryl, wherein aryl is defined as phenyl or naphthyl which is  
optionally substituted with one, two or three of the substituents  
selected from the group consisting of:  
30 (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,  
(b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,  
(c') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,  
(d') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl;  
(e') phenoxy,  
(f') benzyl, and

(g') phenyl optionally substituted with (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl;

(c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, optionally substituted with phenyl; or

(d) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

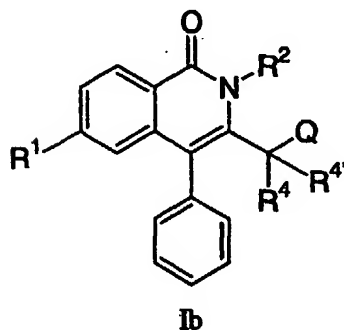
(a') halo, as defined above,

(b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,

(c') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and

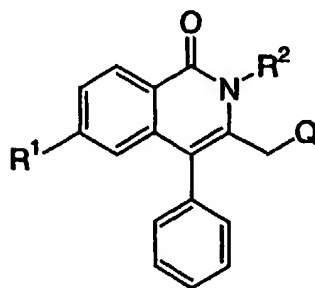
(d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy.

3. The compound of Formula Ib,



wherein the R<sup>1</sup>, R<sup>2</sup>, R<sup>4</sup>, R<sup>4'</sup>, and Q are as defined in Claim 2.

4. The compound of Formula Ic, as recited in Claim 3



Ic

wherein  $R^1$ ,  $R^2$  and Q are as defined below:

$R^1$  is (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or

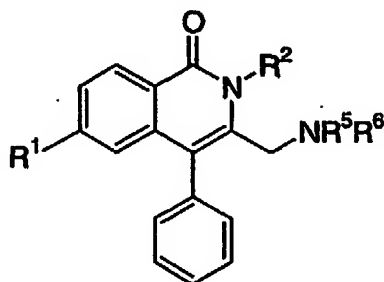
5 halo, wherein halo is fluoro, chloro, bromo, or iodo;

$R^2$  is (C<sub>1</sub>-C<sub>6</sub>)-alkyl; and

Q is heterocyclyl which is selected from the group consisting of: pyrrolidinyl, piperazinyl, imidazolyl, morpholinyl, 1,4-dioxo-8-aza-spiro[4,5]decyl, piperidinyl,

10 and 2,3-dihydroindolyl and the heterocyclyl is optionally substituted with one, two, or three substituents selected from the group consisting of H, (C<sub>1</sub>-C<sub>4</sub>)-alkyl, CF<sub>3</sub>, benzyl, and CO<sub>2</sub>Et.

5. The compound of Formula Id, as recited in Claim 3



Id

wherein  $R^1$ ,  $R^2$ ,  $R^5$ , and  $R^6$  are as defined below:

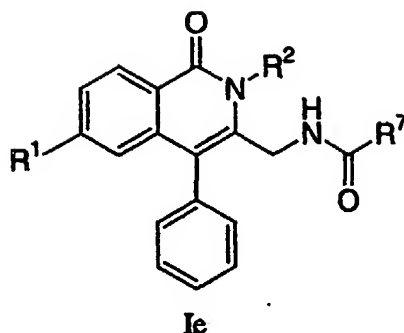
$R^1$  is (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or

20 halo, wherein halo is fluoro, chloro, bromo, or iodo;

$R^2$  is (C<sub>1</sub>-C<sub>6</sub>)-alkyl; and

$R^5$  and  $R^6$  are independently: (C<sub>1</sub>-C<sub>10</sub>)-alkyl optionally substituted with (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and phenyl.

6. The compound of Formula Ie, as recited in Claim 3



wherein  $R^1$ ,  $R^2$ , and  $R^7$  are as defined below:

- 5  $R^1$  is  $(C_1-C_6)$ -alkoxy,  $(C_1-C_4)$ -perfluoroalkyl,  $(C_1-C_4)$ -perfluoroalkoxy, or halo, wherein halo is fluoro, chloro, bromo, or iodo;  
 $R^2$  is  $(C_1-C_6)$ -alkyl; and  
 $R^7$  is:
- 10 (a)  $(C_1-C_{13})$ -alkyl or  $(C_1-C_{13})$ -alkenyl, which is optionally substituted with one, two, or three substituents selected from the group consisting of:
- (a') hydroxy,
  - (b') oxo,
  - (c')  $NR^5R^6$ ,
  - (d')  $NH(CO)O(C_1-C_6)$ -alkyl, wherein  $(C_1-C_6)$ -alkyl is optionally
  - 15 substituted with phenyl,
  - (e')  $CO(C_1-C_{10})$ -alkyl,
  - (f')  $OC(O)(C_1-C_6)$ -alkyl,
  - (g')  $CONR^5R^6$ ,
  - (h') O-aryl, wherein aryl as defined in (l') below,
  - 20 (i') S-aryl, wherein aryl as defined in (l') below,
  - (j')  $(C_3-C_7)$ -cycloalkyl, which is optionally substituted with 1 to 3 substituents selected from the group consisting of  $(C_1-C_6)$ -alkoxy,  $CO(C_1-C_6)$ -alkyl, and oxo, and  $(C_1-C_6)$ -alkyl optionally substituted with  $NO_2$ ,
  - 25 (k')  $(C_5-C_7)$ -cycloalkyl fused with phenyl, wherein  $(C_5-C_7)$ -cycloalkyl fused with phenyl is optionally substituted with 1 to 3 substituents selected from the group consisting of  $(C_1-C_6)$ -alkoxy, oxo, and  $(C_1-C_6)$ -alkyl,



(l') aryl, wherein aryl is defined as phenyl or naphthyl, which is optionally substituted with one, two or three of the substituents selected from the group consisting of:

- (a'') halo, as defined above,
- (b'') hydroxy,
- (c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (e'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, optionally substituted with phenyl,
- (f'') phenyl,
- (g'') phenoxy, and
- (h'') nitro;

(m') heterocyclyl, wherein heterocyclyl is defined as a monocyclic, bicyclic, or tricyclic ring of 5 to 14 carbon atoms which can be aromatic or nonaromatic and containing from 1 to 3 heteroatoms selected from O, N or S, and the heterocyclyl being optionally substituted or with one, two, or three substituents selected from the group consisting of:

- (a'') H,
- (b'') halo, as defined above,
- (c'') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (d'') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (e'') (C<sub>1</sub>-C<sub>4</sub>)-alkyl-aryl,
- (f'') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,
- (g'') phenyl,
- (h'') phenoxy,
- (i'') nitro,
- (j'') CO<sub>2</sub> (C<sub>1</sub>-C<sub>6</sub>)-alkyl, and
- (k'') oxo; and

(n') S- heterocyclyl, wherein heterocyclyl as defined under (m') above;

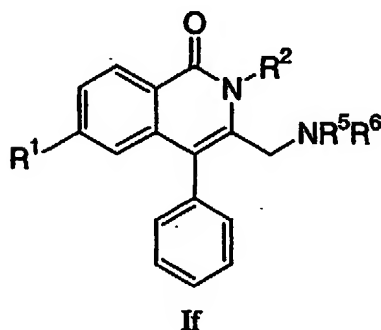
(b) aryl, wherein aryl is defined as phenyl or naphthyl which is optionally substituted with one, two or three of the substituents selected from the group consisting of:

- (a') halo, wherein halo is fluoro, chloro, bromo, or iodo,
- (b') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy,

- (c') phenoxy,
- (d') benzyl, and
- (e') phenyl optionally substituted with (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl;
- (c) (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl, optionally substituted with phenyl; or
- (d) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of:

- (a') halo, as defined above,
- (b') (C<sub>1</sub>-C<sub>6</sub>)-alkyl,
- (c') (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, and
- (d') (C<sub>1</sub>-C<sub>6</sub>)-alkoxy.

7. The compound of Formula If, as recited in Claim 3



wherein R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, R<sup>5</sup>, R<sup>6</sup>, and n are as defined below:

- 20 R<sup>1</sup> is (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or halo, wherein halo is fluoro, chloro, bromo, or iodo;  
 R<sup>2</sup> is (CH<sub>2</sub>)<sub>n</sub>(T)SO<sub>2</sub>R<sup>3</sup> or (CH<sub>2</sub>)<sub>n</sub>(T)COR<sup>3</sup>,  
 R<sup>3</sup> is:

- (a) (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with phenyl;
- 25 (b) phenyl or naphthyl optionally substituted with one, two, or three substituents selected from the group consisting of OCF<sub>3</sub>, O(CH<sub>3</sub>)<sub>3</sub>, CH<sub>3</sub>, CF<sub>3</sub> and halo;
- (c) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy; and

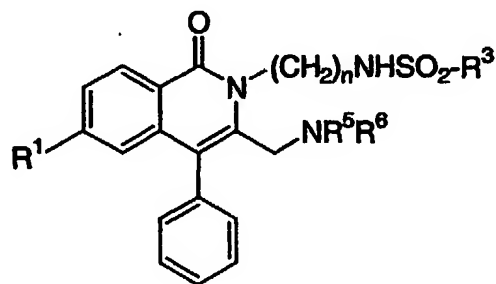
(d) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents selected from the group consisting of (C<sub>1</sub>-C<sub>6</sub>)-alkyl and (C<sub>1</sub>-C<sub>6</sub>)-alkoxy;

R<sup>5</sup> and R<sup>6</sup> are independently:

- (a) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (b) phenyl, and
- (c) (C<sub>1</sub>-C<sub>10</sub>)-alkyl optionally substituted with (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl; and

n is 1, 2, or 3.

8. The compound of Formula Ig, as recited in Claim 3



Ig

wherein R<sup>1</sup>, R<sup>3</sup>, R<sup>5</sup>, R<sup>6</sup>, and n are as defined below:

R<sup>1</sup> is (C<sub>1</sub>-C<sub>6</sub>)-alkoxy, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl, (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkoxy, or halo, wherein halo is fluoro, chloro, bromo, or iodo;

R<sup>3</sup> is:

- (a) (C<sub>1</sub>-C<sub>6</sub>)-alkyl optionally substituted with phenyl;
- (b) phenyl or naphthyl optionally substituted with one, two, or three substituents selected from the group consisting of OCF<sub>3</sub>, O(CH<sub>3</sub>)<sub>3</sub>, CH<sub>3</sub>, CF<sub>3</sub> and halo;
- (c) (C<sub>1</sub>-C<sub>6</sub>)-alkoxy; and
- (d) heteroaryl, wherein heteroaryl is defined as a monocyclic or bicyclic aromatic ring of 5 to 10 carbon atoms containing from 1 to 3 heteroatoms selected from O, N or S, and heteroaryl being optionally substituted with one, two, or three substituents of (C<sub>1</sub>-C<sub>6</sub>)-alkyl;

R<sup>5</sup> and R<sup>6</sup> are independently:

- (a) (C<sub>1</sub>-C<sub>4</sub>)-perfluoroalkyl,
- (b) phenyl, and
- (c) (C<sub>1</sub>-C<sub>10</sub>)-alkyl optionally substituted with (C<sub>3</sub>-C<sub>7</sub>)-cycloalkyl; and

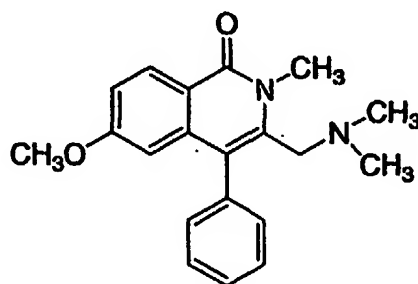
5 n is 1, 2, or 3.

9. The compound of Claim 3 wherein the compound is selected from the group consisting of:

- 3-dimethylaminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 10 3-(2,3-dihydro-indol-1-ylmethyl)-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 3-[(ethyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 6-methoxy-2-methyl-4-phenyl-3-piperidin-1-ylmethyl-2H-isoquinolin-1-one;
- 15 3-[(*tert*-butyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 3-[(isopropyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 3-[(isopropyl-methyl-amino)-methyl]-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one;
- 20 6-methoxy-2-methyl-4-phenyl-3-[(2,2,2-trifluoro-ethylamino)-methyl]-2H-isoquinolin-1-one;
- 2-(5-methoxy-2-methyl-1H-indol-3-yl)-N-(6-methoxy-2-methyl-1-oxo-4-phenyl-1,2-dihydro-isoquinolin-3-ylmethyl)-acetamide;
- 25 N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-methanesulfonamide;
- butane-1-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide;
- thiophene-2-sulfonic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide;
- 30 N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-benzenesulfonamide;
- furan-2-carboxylic acid [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-amide;

- N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-2-phenyl-acetamide hydrochloride;  
 N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-nicotinamide;  
 5 9-methoxy-2-methyl-11-phenyl-1,2,3,4-tetrahydro-pyrazino[1,2-b]isoquinolin-6-one;  
 2-(1-acetyl-piperidin-4-ylmethyl)-3-dimethylaminomethyl-6-methoxy-4-phenyl-2H-isoquinolin-1-one;  
 3-dimethylaminomethyl-2-(1-methanesulfonyl-piperidin-4-ylmethyl)-6-methoxy-4-phenyl-2H-isoquinolin-1-one;  
 10 [2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-carbamic acid *tert*-butyl ester;  
 N-[2-(3-dimethylaminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-isonicotinamide; and  
 15 [2-(3-aminomethyl-6-methoxy-1-oxo-4-phenyl-1H-isoquinolin-2-yl)-ethyl]-carbamic acid *tert*-butyl ester.

10. The compound of Claim 3 wherein the compound is 3-dimethylaminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one or a pharmaceutically acceptable salt, hydrate, solvate, crystal forms and stereoisomer thereof as shown below:



- 25 11. A method of treating a condition in a mammal, the treatment of which is effected or facilitated by K<sub>v</sub>1.5 inhibition, comprising the administration of a therapeutically effective amount of the compound of Formula I as recited in Claim 1.

12. A method of treating a condition in a mammal, the treatment of which is effected or facilitated by potassium current,  $I_{K_{ur}}$ , comprising the administration of a therapeutically effective amount of the compound of Formula I as recited in Claim 1.

5

13. A method of treating a condition in a mammal, the treatment of which is effected or facilitated by  $K_v1.5$  inhibition, comprising the administration of a therapeutically effective amount of pharmaceutical composition which comprises a pharmaceutical carrier and a compound of Formula I as recited in Claim 1.

10

14. A method of treating a condition in a mammal, the treatment of which is effected or facilitated by  $I_{K_{ur}}$  current inhibition, comprising the administration of a therapeutically effective amount of pharmaceutical composition which comprises a pharmaceutical carrier and a compound of Formula I as recited in Claim 1.

15

15. A method of preventing or treating atrial arrhythmias in a mammal, comprising the administration of a therapeutically effective amount of the compound of Formula I as recited in Claim 1

20

16. A method of preventing or treating atrial arrhythmias in a mammal comprising a therapeutically effective amount of 3-dimethylaminomethyl-6-methoxy-2-methyl-4-phenyl-2H-isoquinolin-1-one or a pharmaceutically acceptable salt, hydrate, solvate, crystal form, and stereoisomer thereof.

25

17. A pharmaceutical composition for the treatment of an atrial arrhythmia, comprising a pharmaceutically acceptable carrier and at least one compound of Formula I or its pharmaceutically acceptable salt, hydrate, solvate, crystal form, and stereoisomer thereof as recited in Claim 1.

30

18. A process for making a pharmaceutical composition comprising a compound of Formula I or its pharmaceutically acceptable salt, hydrate, solvate, crystal form, and stereoisomer thereof as recited in Claim 1 and a pharmaceutically acceptable carrier.

5

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/29013

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C07D 217/24; A61K 31/472

US CL : 546/141; 514/309

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 546/141; 514/309

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
CAS ONLINE

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HP 634402 A1 (TAKEDA CHEMICAL INDUSTRIES, LTD) 18 January 1995 (18.01.1995), see formula I and the Examples.	1-3, 6, 17-18
X	US 5,482,967 A (Natsugari et al) 09 January 1996 (09.01.1996), see formula I and the Examples 101-227.	1-3, 6, 17-18

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

<p>* Special categories of cited documents:</p>	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

16 December 2001 (16.12.2001)

Date of mailing of the international search report

16 JAN 2002

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks  
Box PCT  
Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized officer

Deepak Rao *Felicia E. Roberts*

Telephone No. (703) 308-1235